DOCUMENT RESUME

ED 288 632 PS 016 968

AUTHOR McGuire, Judith S.; Austin, James E.
TITLE Beyond Survival: Children's Growth for National Development. Assignment Children, 1987-2.
INSTITUTION United Nations Children's Fund, New York, N.Y.
PUB DATE 87
NOTE 62p.; For related document, see PS 016 967.
AVAILABLE FROM Assignment Children, UNICEF Programme Division, UNICEF, UNICEF House, 3 United Nations Plaza, New York, NY 10017 ($3.00).
PUB TYPE Viewpoints (120)

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS *Children; *Developing Nations; *Economic Development; Global Approach; *Government Role; Health Services; Intervention; *National Programs; *Primary Health Care; Program Development; Public Policy; Research Needs
IDENTIFIERS *Child Survival and Development Revolution

ABSTRACT

The primary purpose of this paper is to set forth the rationale for governments' undertaking of strategies that promote the growth of children. The rationale has three dimensions: economic, humanitarian, and political. The primary focus of this paper is on the economic arguments, although the main humanitarian and political arguments are also indicated. The economic rationale is threefold: improved child growth leads to a more productive adult work force, increases the return on the country's educational investment, and makes more efficient use of health care resources. Concerning programmatic action, the multiple etiology of growth retardation dictates that various types of growth promotion interventions are required. Six action areas are considered important: motivational campaigns, growth monitoring, food and income interventions, health interventions, child spacing, and child care. As intervention occurs, benefits will accrue from the research of growth-promoting and long-term effects of intervention programs; aspects of parental behavior such as family dynamics and decision making; and implementation experiences, including political mobilization, strategy formulation, program organization, and cost effectiveness. A reference list offers over 100 items. (RH)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED288632

ASSIGNMENT CHILDREN

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

X This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

Beyond survival:

children's growth for national development

PS 016968

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Pierre-E. Mandl
UNICEF
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

2

The opinions expressed in this report are those of the authors and not necessarily those of the United Nations Children's Fund.

Library of Congress catalogue card number: 68-377

UN ISSN 0004-5128
© United Nations Children's Fund 1987.

Editor
Dr. Pierre-E. Mandl

Assignment Children
UNICEF Programme Division, UNICEF, UNICEF House,
3 United Nations Plaza, New York, N.Y. 10017, USA

UNICEF, Palais des Nations,
CH-1211 Geneva 10, Switzerland

Beyond survival:

children's growth for national development

Judith S. McGuire
Principal Investigator
Resident Fellow, Resources for the Future
National Center for Food and Agricultural Policy

James E. Austin
Project Director and Chairman
J.E. Austin Associates, Inc.
Professor of Business and Administration
Harvard University

unicef

1987-2

4

Contents

Executive summary	VII
The problem	1
The growth concept	5
Rationale for child growth promotion	7
Economic rationale	7
Production and productivity	7
Physical work capacity	8
Mental development	10
Work loss	10
Educational returns	11
Intelligence and school behaviour	12
School enrolment	15
Grade completion and repetition	15
Health care resource use	17
Increased demands on resources	17
Resource savings	20
Humanitarian rationale	21
Political rationale	22
Growth promotion action areas	25
Motivational campaigns	26
Growth monitoring	27
Food and income interventions	30
Health interventions	33
Child spacing promotion	36
Child-care behaviour	37
Integration considerations	38

Contents

Further research	39
Growth linkages	39
Parental behaviour	39
Implementation experiences	40
Annexes	43
References	45

Acknowledgements

We wish to express our appreciation to the following reviewers and other experts for their contributions to the preparation of this study:*

***John Akin**, The World Bank*
***Howard Barnum**, The World Bank*
***Jere Behrman**, University of Pennsylvania*
** **Alan Berg**, The World Bank*
***Rolf Carrière**, UNICEF*
** **David Dapice**, Tufts University*
** **Hossein Ghassemi**, UNICEF*
***Gail Gibbons**, American Public Health Association*
***Marcia Griffiths**, Manoff International*
***Lukas Hendrata**, UNICEF*
***Dean Jamison**, The World Bank*
***Emmanuel Jimenez**, The World Bank*
***Maureen Lewis**, The Urban Institute*
***Frank Method**, AID*
***Robert Myers**, High/Scope Educational Foundation*
** **Catherine Overholt**, Harvard School of Public Health*
***Nancy Pielemeier**, AID*
** **Per Pinstrup-Andersen**, IFPRI*
***Marian Zeitlin**, Tufts University*

This project would not have been realized without the initiative, dedication and conceptual insights of Dr. Hossein Ghassemi; for his vision and commitment we are most grateful. We wish to thank also Ms. Anna Jiggh, Research Assistant, for her invaluable bibliographic assistance.

We alone remain responsible for the content of the paper.

Executive summary

The international community, in collaboration with national governments, is making strides towards saving children's lives. These critically important survival interventions rescue children; they constitute essential but insufficient action. The major challenge of the future is to move beyond survival. Poor children saved from the clutches of death face undernutrition, high morbidity and deprived environments—forces that rob the children of their growth potential. They become physically and mentally less productive adults and are more likely to perpetuate the poor growth syndrome in the next generation.

Beyond survival lies the pursuit of growth. The task is to unlock children's potential. Forty per cent of the world's children under five years of age, 141 million, are chronically undernourished. The concept that growth-retarded children are stunted but healthy and therefore need no attention is false; for these children and their countries, small is unhealthy. Growth promotion strategies can lead to stronger, smarter and healthier children and adults. A country's human capital is enhanced. Investing in children's growth accelerates national development.

Rationale for child growth promotion

The primary purpose of the paper is to set forth the economic rationale that will motivate governments to undertake growth promotion strategies. The main humanitarian and political arguments are also indicated.

The economic rationale is threefold: improved child growth leads to a more productive adult work-force, increases the returns on the country's educational investment and makes more efficient use of the health care resources.

Production and productivity—Improved childhood growth increases physical capacity for work as adults. There is an indisputable

link between body size, aerobic capacity and endurance. Bigger workers in physical jobs have demonstrated higher productivity in the range of 15 per cent. There is also a documented link between growth and enhanced mental development. Growth retardation adversely affects motor and mental functions. Investments in growth promotion strategies have been estimated to improve Gross National Product (GNP) by 0.6-2.2 per cent due to the improved productivity. Furthermore, growth-retarded children are ill more often and for longer periods. Reducing these illnesses could save annually a globally estimated 200 million adult workdays which are lost due to giving or obtaining health care for the sick children. Children themselves perform many economically productive functions and if they are healthier, their productivity will be greater.

Educational returns—Children who have suffered from chronic malnutrition and/or inadequate stimulation in their early years tend to have lower I.Q.s and poorer performance in school. Children who had benefited from growth promotion strategies such as early supplementation and/or stimulation had higher enrolment rates, paid better attention in school and answered teachers' questions more often. They stayed in school longer and had lower grade-repetition rates. Such improvements in student performance could generate savings or enhanced efficiencies equivalent to two per cent of national expenditures on education, which is often one of the major items in national budgets.

Health care resource use—Poor growth is accompanied by increased incidence, duration, severity and complications of illnesses. An estimated additional 1.1 billion days per year of child illness are due to growth retardation. This raises the demand for curative services and requires more expensive intervention in terms of personnel, facilities and medicines. Growth promotion strategies are fundamentally preventive measures. Economical early actions can significantly reduce the more costly subsequent curative interventions.

The humanitarian rationale for growth promotion strategies is also strong. It is morally incumbent upon society to care for those members who cannot look out for themselves. The quality of the next generation is a public good that must be attended to. The existence of technologically and economically feasible methods make the alleviation of child suffering and the enablement of their full

potential a moral imperative. Furthermore, the right to growth can be seen as a basic human right flowing out of the right to food, health, housing and education.

The political rationale has several aspects. Growth promotion is a positive theme which has broad appeal across economic, social, political and ethnic lines. Growth promotion interventions provide multiple opportunities for highly visible demonstrations of the government's concern for the people's well-being and are a means of pre-empting criticisms of inaction or non-concern from political opponents. A final important political pay-off from growth promotion is the potential for rapid results on several fronts.

Growth promotion action areas

On the programmatic action side, the multiple aetiology of growth retardation dictates that various types of growth promotion interventions are required. These should be viewed with an integrative perspective, even though quite diverse administrative configurations can be devised to fit differing country circumstances. Six action areas are important:

Motivational campaigns—A prerequisite to programme viability is self-sustaining demand. Target beneficiaries and the body politic must be sufficiently motivated to initiate and to continue the growth promotion strategy. This requires an explicit effort to communicate to parents, community leaders, health professionals and political leaders the importance of child growth to their various perspectives and how it can be achieved.

Growth monitoring—This is a core element in growth promotion strategies. Monitoring by itself is meaningless. It can be critical as a vehicle for unifying and linking the various growth promotion actions. Monitoring serves as a motivator for parents and communities and as a communication channel with health promoters. New types of nutrition education are an integral part of growth monitoring.

Food and income interventions—Of the various types of feeding programmes, pre-natal supplementation has the clearest positive growth effect (through increased birth weights). Child feeding programmes may be cost-effective if they are sharply targeted and linked to growth monitoring. The effects of food subsidy and food produc-

tion interventions are also dependent on their being carefully linked to the target population. Increased breast-feeding has clearly documented positive effects.

Health interventions—Immunization and oral rehydration therapy (ORT) interventions have clearly demonstrated effects on child survival but have not been well evaluated for their growth outcomes. Because of the documented links between nutrition and infections, disease control through medical treatment and improved sanitation is highly desirable.

Child spacing—Birth intervals of less than two years adversely affect growth, morbidity and mortality risks. Promoting spacing would appear to be a potentially cost-effective action area.

Child care—Growth and development of children is strongly influenced by the quality of interactions between care-givers and the child. Actions to enhance child care represent a relatively untapped but quite promising area for growth promotion.

We conclude that sufficient evidence exists to argue for children's growth promotion as a priority in national development, and existing experience indicates promising areas of intervention. The probability and magnitude of the potential development gains are great enough to justify vigorous pursuit of the growth promotion strategies even in the face of imperfect information.

Further research

Simultaneously, it would be highly beneficial to pursue research in three areas: growth linkages, parental behaviour and implementation experiences.

Growth linkages—More data are needed on the growth promotion (in addition to survival) effects of health, population, education, and food and income programmes. Research should also document more clearly the carry-over effects of childhood growth on adult performance in terms of physical capacity, cognitive dysfunction and health status.

Parental behaviour—Knowledge is inadequate about the causes and consequences of parental investment in child behaviour. Growth retardation must be caused by more than poverty because half of

the world's poor children grow adequately. Family dynamics and decision making merit exploration.

Implementation experiences—The documentation of country and programme experiences with growth promotion strategies will facilitate and accelerate programmatic actions. Lessons need to be drawn regarding political mobilization, strategy formulation, programme organization and cost-effectiveness.

UNICEF is in a unique position to lead the advocacy effort for child growth promotion strategies. The momentum from its child survival efforts, its high international credibility and its global network create favourable conditions for effective action.

The problem

Death at an early age exacts a great emotional loss, but the chronic deprivation of living children is a much more prevalent and directly costly occurrence world-wide. In developing countries, this wastage is set in motion primarily by undernutrition, poor health and inadequate mental stimulation of children under three years of age.

UNICEF calculates that about 14 million children under five years of age die annually; half of these deaths could be prevented by implementing available low-cost solutions. Undernutrition is a direct or contributing cause of more than half of early childhood deaths (Puffer and Serrano, 1973). In addition, 141 million living children between six and 60 months of age are chronically undernourished—almost 40 per cent of the world's children (Haaga, Kendrick, Test and Mason, 1985). Rural areas show higher prevalence of undernutrition than urban ones, although the degree of nutritional deficiency of the urban poor is frequently greater (Austin, 1980). Asia has the greatest numbers of children at risk of growth failure—approximately 60 per cent of the total—followed by Africa (14 per cent), the eastern Mediterranean (13 per cent), and the Americas (8 per cent). Asia also has the highest prevalence of growth failure: 52 per cent of Asian children are under 80 per cent weight-for-age, followed by Africa and the eastern Mediterranean with 35 per cent each and the Americas with 21 per cent of children underweight (see Table 1).

Children who are most at risk of undernutrition, morbidity, retarded mental development and mortality share one common attribute: poor growth in the first three years of life. Those children become less productive adults and are more likely to perpetuate the poor growth syndrome in the next generation.

The primary purpose of this paper is to set forth the rationale for governments to undertake child growth promotion strategies. This rationale has three dimensions: economic, humanitarian and political. Our focus is primarily on the economic arguments.

The direct economic costs of poor growth to national develop-

TABLE 1

Children under 80 per cent weight-age

	Number	Millions	As % all children in region
Africa	20	(14.2)	34.9
Americas	12	(8.5)	21.0
South/East Asia	83	(58.9)	51.9
Europe	2	(1.4)	26.3
East Mediterranean	18	(12.8)	35.1
West Pacific	6	(4.2)	23.0
World	141	(100.0)	39.3

Source: Haaga, Kendrick, Test and Mason (1985). Medium variant.

ment are high in terms of lost productive capacity, reduced returns on a country's investment in education, and higher health care costs. The indirect costs such as fatalism, lack of community participation, apathy and child neglect may be less tangible economic costs, but they are certainly detrimental to the development process.

From the humanitarian perspective, the need to alleviate the suffering of growth-deprived children and to enable them to develop to their full potential are moral imperatives for any responsible government. This is especially so, given that technologically feasible and economically affordable means of growth enhancement exist.

The political benefits of improving children's growth are potentially high. It provides a means of galvanizing all the population into action around a single popular issue, visibly demonstrates governmental concern for people's welfare and derails attempts by political opponents to use malnutrition as a rallying cry.

The remaining parts of this paper address four key questions:

(1) Why look at growth?

Growth measures are defined and presented as integrative indicators of health status. The argument of 'small but healthy' is rejected.

(2) What is the development rationale for child growth promotion strategies?

The economic arguments supporting the strategies are presented based on the theoretical and empirical evidence from the biological and social science literature. The humanitarian and political arguments are briefly discussed, but primary emphasis is on the economic dimension.

(3) How can child growth be improved?

Growth promotion requires multiple types of interventions. The following action alternatives are examined: motivational campaigns, growth monitoring, nutrition education, food interventions, health measures, child spacing and child care.

(4) Where are the knowledge gaps?

Existing evidence is sufficient to justify child growth strategies, but additional research in certain specified areas would accelerate and enhance programmatic actions.

The growth concept

This paper focuses on growth promotion for children. Child survival is but one of several concomitants of adequate growth—others include improved physical and cognitive development, increased functional capacity and improved health. Albeit crude, the measure of growth used here is body size: weight or height relative to standards. In the first few years of life, weight is the most widely accepted indicator of growth, particularly under field conditions in developing countries. If monitored continuously, weight provides an easy and accurate assessment of a child's health status. When repeated measures are not available, however, as in cross-sectional data, weight becomes a less specific measure of health and nutritional status because, as children become malnourished, their weight and their height deviate increasingly from standards. A reading of 60 per cent weight-for-age of a two-year old could mean either a very short but normally proportioned child or a child of normal stature who is nutritionally wasted. In order to aid interpretation, especially for population-level problem diagnosis and targeting, it is preferable to know the height and weight of children. Height serves as a proxy for lifelong health and nutrition problems, and weight-for-height indicates the severity of current problems.

Since the late 1970s, a small group of development experts has been promoting the concept called 'small but healthy.' They contend that 90 per cent of malnourished people are chronically malnourished—"abnormally short but otherwise perfectly normal"—and that "no nutritional intervention program can do anything about" chronic malnutrition (Seckler, 1979). Subsequent supporters of this position have asserted that early childhood morbidity and mortality are affected only by acute, severe undernutrition rather than by chronic and moderate malnutrition. However, recent review of their supporting evidence plus other literature (McGuire, forthcoming) fails to show empirical proof for their position. The following factors lead us to reject the 'small but healthy' position:

- Acute severe malnutrition is neither sensitive nor specific as a predictor of mortality—moderate chronic undernutrition is more reliable.
- Immune function is compromised progressively as nutritional status worsens; the immune system does not wait for severe acute malnutrition. Infections, moreover, contribute to deterioration of nutritional status. Duration, severity and case fatality but not incidence of illness are affected by moderate as well as severe undernutrition.
- Chronic undernutrition, because of the duration of impairment of the child's interaction with his or her environment, seems to have more profound effects on mental development than an isolated case of severe acute malnutrition.
- Short stature with low but not abnormal weight-for-height is associated with reduced strength, endurance and work productivity.
- Short women who do not gain much weight over pregnancy run a higher risk of having low-birth-weight babies than taller women with inadequate weight gain. Low birth weight is a risk factor for infant mortality and morbidity.

These functional effects of growth retardation are discussed in the economic rationale section that follows.

Of key importance in examining the 'small but healthy' hypothesis is the age of the person who is small. The process of stunting and its negative outcomes can be prevented or reversed in children under three. Even five-year-olds respond to intervention. An older child or adult who is stunted can partially compensate for nutritionally induced dysfunction but will never gain full height potential. If one is examining young children, then, growth promotion intervention can have major positive effects. For older people, the 'small but healthy' proponents are correct in stating that stunting is permanent, even though some remedial action is possible.

Rationale for child growth promotion

Identifying growth failure as a pervasive injustice is not sufficient reason for a policy maker to allocate scarce resources to attacking the problem. In the real world of budget deficits and negative real growth in revenues, new endeavours must make their case in competition with other important existing or new programmes, and the resource allocation decision often rests on economic efficiency and political expedience. This is not to say that moral and humanitarian concerns are irrelevant—they are a motivating factor and enable policy makers to make a leap of faith where hard evidence is lacking. Traditionally, advocacy efforts to promote growth in children have emphasized the humanitarian rationale. We will now set forth the economic case.

Economic rationale

The economic arguments supporting child growth promotion are threefold. Enhanced growth will: (1) increase national production and productivity; (2) enhance school performance, thereby improving the return on the country's educational investments; and (3) make more efficient and effective use of the nation's health care resources.

1. Production and productivity

Human capital—physical and mental—is the most abundant development resource in the Third World and is essential to the development process. Recent surveys of the literature (Behrman and Deolalikar, 1986; Gwatkin, 1983; Horton and King, 1981) have concluded that improved health and nutrition of the work-force is a necessary condition for maximum productivity. Industrial and agricultural technology—to say nothing of 'high' technology—can

go nowhere without sufficient complementary human resources of the right quality to take advantage of it. For the foreseeable future, the greatest demand will be for a healthy, well-nourished and increasingly literate and numerate work-force. Child growth directly affects national production through its effects on physical work capacity, mental development and work loss.

(a) Physical work capacity. Most of the evidence supporting the growth-productivity link derives from small, biologically oriented studies (see Annex 1). The scientific studies show an indisputable link between body size and aerobic capacity and endurance. Such physical capacity is a basic determinant of productivity in a multitude of economic activities in agriculture, construction and mining. Shorter people, of the same degree of leanness, have less muscle mass, and muscle mass is the key determinant of aerobic capacity. Aerobic capacity has been found to be associated with work productivity among lumberjacks (Hansson, 1965, cited in Spurr, 1984), and among sugar cane cutters in East Africa (Davies, 1973), Australia (Morrison and Blake, 1974), Sudan (Davies et al., 1976), Guatemala (Viteri and Torun, 1975) and Colombia (Spurr et al., 1977).

It is possible through training and good nutrition to increase muscle mass in adults and compensate for the physical effects of early growth retardation, but most people in developing countries do not have adequate opportunity to do so. Even studies that attempt to increase productivity by feeding workers have not generally been successful. Immink and Viteri found that, irrespective of supplementation, height was a greater predictor of productivity than current intake. Many studies have found that individual productivity is proportional to weight but rarely have they controlled for height and training, making it difficult to attribute differential capacity to past rather than present undernutrition and physical fitness.

The net economic effects of improved growth can be substantial:

- In *Guatemala*, investigators calculated that tall sugar cane cutters increased the present value of lifetime earnings (up to age 62) by 16 per cent compared to short cane cutters, undernourished since childhood, presumably (Immink et al., 1984).

- In *Chile*, Selowsky and Taylor (1973) calculated that food supplementation for children under two would result in productivity

gains equivalent to the present value of one per cent of Chile's domestic product.

- Using data from the *Cali, Colombia* early intervention project, Selowsky (1981) calculated positive rates of return from integrated nutrition/early education programmes ranging from 0.6 to 2.2 per cent of GNP (depending on per capita income in the country).

The realization of the enhanced productive potential of an adult who benefited from improved growth as a child may be impeded by nutritional deficiencies being experienced as an adult. For example, iron deficiency has been shown to affect adversely work capacity (Spurr, 1983). Thus, to obtain the full return on the investment in child growth, a government may have to make modest incremental investments in nutrition interventions for adults. Studies of rubber workers in Indonesia (Basta et al., 1979) and road workers in Kenya have shown that iron supplementation can improve productivity of adults. Levin (1986) calculates that for every 10 per cent rise in haemoglobin there is a rise in work output of 10 to 20 per cent. Using cost data on fortification and supplementation programmes, he calculates the cost-benefit ratio of iron programmes to be 7 to 70 for food fortification and 4 to 38 for supplementation. A current World Bank supplementation programme for rubber workers in Indonesia will provide better cost-effectiveness data for such analysis. One should consider the child growth interventions as the primary investment and these adult interventions as follow-on supporting investments.

Physical capacity is only one determinant of productivity. Intervening factors that potentiate or negate the advantages of increased biological capacity include organization of the work-place, motivation, basis of wage rates, current illness, technology and social dynamics, among others. Because of these factors, studies that have attempted to link nutrition to work output have produced confounding results and certainly not found a one-to-one relationship between improved growth and productivity. It is reasonable, however, to think of improved child growth as expanding the potential future work capacity of the adult labour force, if it is appropriately tapped. However, given the very young age at which children in poor families begin to perform economically productive and valuable activities, the benefits from enhanced work capacity begin to accrue during childhood. Children are a significant part of the labour force.

(b) Mental development. Labour productivity is determined by intellectual factors as well as physical capacity. The link between education and productivity and national development is well established (Schultz, 1980; Hicks, 1980; Wheeler, 1980). Growth retardation has been repeatedly shown to affect a wide variety of measures of motor and mental function (Pollitt and Thomson, 1977). It is just as clear, however, that the lack of nutrients is only part of the problem—the sensory environment of the child is equally important both to the growth process and to mental development. Undernutrition affects brain growth, attention span and short-term memory but it also affects activity levels (which increase the sensory input), affect (which changes caretaking behaviour and rewards for parents) and general interaction with the environment. These developmental processes may simply be retarded in time (Dasen et al., 1977), but the failure to catch learning opportunities at specific points in the child's physical or chronological age may introduce irreversible cognitive deficits.

Much discussion in the early 1970s revolved around the concept of a 'critical period' in the brain's development during which environmental (including nutritional) insult would cause irreversible damage because that was the period of the brain's greatest growth. It is well accepted now, however, that adequate nutrition and stimulation after that brain growth spurt can totally compensate for earlier insults (except perhaps severe deprivation *in utero*). Dobbing (1985) sums up the current consensus as follows, "Promotion of the best somatic growth possible in the period before the second or even the third birthday is the most we can do to assure good brain growth."

There is almost a total lack of empirically based longitudinal studies examining adult competence as a function of early childhood undernutrition or lack of stimulation. Poor attention span, retarded language development and reduced exploratory behaviour that persist into adulthood, have serious effects on the ability of adults to participate in national economic development, regardless of whether as children they attended school or became literate.

(c) Work loss. Children's illness directly affects adult productivity when parental time is shifted from productive activity to nursing care or to the pursuit of health care. Since poor nutrition increases the prevalence and duration of illness and the risk of complications, the need to seek professional care is increased. It is usually the

mother's time which is absorbed by the health care tasks. This very likely affects family production adversely, given the many productive activities carried out by women, particularly in agriculture.

Both the prevalence and duration of illness is greater for growth-retarded children (see Health care resource use section). We estimate the additional days of illness to be eight days per child or 1.2 billion total added sick days annually for the world's 141 million growth-retarded children. If, for every eight sick days of a child, parents lose one to two workdays, then total work loss would be between 140-280 million adult days plus the sick child's forgone labour.

Furthermore, if the child requires hospitalization or professional treatment, often the family has to use up its savings or go into debt. This diverts resources from direct production investments and may trigger a disastrous deterioration in the family's fragile economic situation.

To the extent that improved child growth and health status carries over into adulthood and contributes to extending the work life, reducing illnesses and, therefore, absenteeism, then growth reduces work loss. These linkages have not been clearly delineated empirically except, of course, in that improved child survival saves a future worker.

2. Educational returns

Educational expenditures constitute an average of 15 per cent of public budgets in developing countries (Psacharapoulos, Tan and Jimenez, 1986), yet literacy remains low. One quarter of children are not enrolled in primary school, and one third of children drop out before finishing sixth grade. The greatest social returns in education come from primary education (28 per cent), and future enrolment in primary schools will come increasingly from poorer segments of the population who are more likely to be growth-retarded.

This section discusses the effects of growth retardation on school performance and educational efficiency. Early childhood experiences are reflected in various parameters of educational performance: IQ., enrolment, absenteeism, promotion/repetition, and drop-out rates.

One source of the adverse carry-over effects on school performance is pre-schooler sensory deprivation. In the USA, studies of failure-to-thrive children show a clear role of sensory deprivation in the causality of growth failure (Pollitt, 1975 a,b, 1976). In Uganda, Geber

and Dean (1956) found that the rate of recovery from severe malnutrition was related to maternal behaviour. Zeitlin and Mansour's recent report (1986), documents numerous examples of care-giving behaviour that adversely affects nutrition. They have also shown that within homogeneous low-income groups the difference between children who grow adequately and those that are growth-retarded rests in large part on the aggressive intervention of the mother in feeding and illness. Often the source of deprivation is originally the child itself—an incompetent, low-birth-weight baby, an apathetic child in the process of adapting to insufficient food intake, the irritable and petulant child who has just been weaned, or the unattractive, weepy, malnourished child. Insufficient or inappropriate cues from the child are matched by depriving actions on the part of the parents who do not have the time, training or motivation to overcome the child's difficult behaviour. This sort of neglect may also pertain to teachers who may be less interested in the progress of the short, sickly child (Mushkin, 1979).

(a) Intelligence and school behaviour. Several studies have linked early undernutrition to performance on standardized tests of intelligence or cognitive function, and I.Q. has generally been assumed to be highly correlated with school performance (Irwin et al., 1978).

- In *Guatemala*, one of the earliest studies (Cravioto, DeLicardie and Birch, 1966) showed that neuro-integrative functions of six-to-eleven-year-old children were compromised in chronically undernourished children, although differences tended to disappear with age.

- The four-village study in *Guatemala* (Lasky et al., 1981) found pre-school and school-age mental retardation related to height (a measure of chronic undernutrition), and others in that group found behaviour at school age also to be impaired (Barrett and Radke-Yarrow, 1985).

- In *Mexico*, Chavez and Martinez (1981) found significant differences in behaviour at school, but not in school-age I.Q., of chronically undernourished compared to supplemented children. They also found that I.Q.s of supplemented children dropped while attending school, while I.Q.s of unsupplemented children stayed the same or improved.

- In *Cali, Colombia*, investigators found significant difference in I.Q.s of children who had been supplemented and stimulated since three or four years of age at five and eight years of age (McKay, McKay and Sinisterra, 1974; McKay, Sinisterra, McKay, Gomez and Lloreda, 1978). The experimental children were also more likely to be promoted (Halpern and Myers, 1985).

- In *Bogotá, Colombia*, researchers found significant effects of supplementation (pre-natally and up to age three), stimulation, and both together on intelligence test performance between four months and five-and-a-half years (Weber et al., 1981; Mora et al., 1974).

- In the *Philippines*, Popkin and Lim-Ybanez (1982) examined the relationship between nutrition (weight-for-height and haemoglobin) and performance on achievement tests of Filipino children aged 12 to 14. They found anaemia affected language score but otherwise nutritional status had no effect on achievement scores. Since the measures used were of current nutritional status, that study has little to say about the effect of growth retardation *per se* on school performance.

- In *Indonesia*, Pollitt (1984) found that iron deficiency anaemia negatively affects attention span and school performance. Anaemic children given iron supplementation for three months closed the gap between them and non-anaemic control children in achievement scores and concentration.

- *Jamaican* children with a history of severe malnutrition were tested at school age (Richardson, 1975, 1976), and it was found that children who had undergone chronic undernutrition in conjunction with social deprivation (regardless of whether they had had a severe malnutrition episode) had significantly reduced I.Q. scores, worse school performance and less socially acceptable behaviour than less deprived children.

- In the *USA*, comprehensive health, nutrition and intellectual stimulation programmes (Head Start and others like it) were originally shown to have modest effects on I.Q. that disappeared after programme completion. Recent studies of young adult performance of participants, however, has shown profound differences in social competence: the ability to support themselves, teenage pregnancies, and delinquency (Halpern and Myers, 1985).

- Even non-impoverished *U.S.* populations show an effect of growth on I.Q. Findings from a national survey (Wilson et al., 1986) show that taller children six to 17 years old consistently performed better on I.Q. tests after controlling for income, race, family size and birth order. They conclude that "processes that contribute to the association between height and I.Q. must occur relatively early in childhood". They speculate, however, that social norms which cause height bias may favour the intellectual development of taller children—which could be true in developing countries as well.

Children's day-to-day behaviour is also related to chronic and acute malnutrition, and this behaviour probably correlates with effective learning. Chavez and Martinez (1981) found that Mexican children who were supplemented from birth to three months paid better attention in school, answered the teacher's questions more often and slept less than unsupplemented children. Supplemented children were not only better nourished but had shown increased activity levels from early infancy, which resulted in increased parental attention.

Two studies in Latin America have attempted to link early malnutrition with adult earnings through its effect on schooling. Selowsky and Taylor (1973) use Chilean data on differential I.Q. of normal and growth retarded (under 75 per cent weight-for-age) children three to three-and-a-half years old, I.Q. and earnings of employed and unemployed manual workers, and correlations between four-year-old and adult I.Q. scores to estimate the economic cost of early growth retardation. They found that a 10 per cent difference in adult I.Q. was matched by a six to seven per cent increase in earnings with no effect of schooling noted. This increase in adult I.Q. corresponds to a 14-20-point increase in four-year-old I.Q. (the actual difference between malnourished and well-nourished children was 14.3 points). The authors note, however, that the I.Q.s of the malnourished children were likely to deteriorate unless special schooling was provided, so the adult difference would likely be even greater than 10 per cent).

Selowsky (1981), in a similar exercise for Colombia, extrapolated from the Cali study (nutrition and stimulation for children three to six years old) using several bold assumptions*, and he concluded

* e.g. "The marginal product of additional schooling [depends] on the level of preschool abilities in the child" and that one standard deviation in I.Q. is equivalent regardless of test and age at testing.

that the income gains from early childhood intervention are equivalent to those from one to three additional grades at school. If children are better nourished and stay in school one to three years longer, then the difference in lifetime earnings of children who would have dropped out after first grade is 2.5 to 5.6 times that of the unschooled child and 4 to 8.9 times that of fourth-grade school leavers.

(b) School enrolment. Since cost per student decreases as enrolment ratio increases, increased enrolment could be a source of increased educational efficiency. Several investigators have found that growth outcome was a significant determinant of school enrolment: bigger children were sent to school.

- In *Nepal*, Moock and Leslie (1986) found both weight-for-height and height-for-age, in probit analysis, to be significant determinants of enrolment.
- The four-village study in *Guatemala* also found that bigger children were more likely to be enrolled (Balderston et al., 1981; Klein, 1979).
- The *Bogotá, Colombia* study found that maternal tutoring but not supplementation enhanced timely school enrolment.

It seems that if parents detect some indicator of school readiness or intellectual promise in children they are more likely to enrol the child. For instance, Irwin (Irwin et al., 1978) found that parents' (correct) assessment of children's intellectual competence was a key determinant of enrolment in Guatemala.

One of the major reasons for non-enrolment of children is their opportunity cost to the family. Jimenez (1987) calculates that about half of the cost of educating a child is borne by the parents, primarily in opportunity costs. Since improving children's growth also increases their work productivity, hence raising the opportunity cost of schooling, one might not expect increased enrolment to result from better children's growth unless parents perceive improved returns to education based on better school performance of a more robust child.

(c) Grade completion and repetition. With respect to economic efficiency of fiscal outlays for education, the outcomes of greatest interest are grade completion and repetition. Recent studies have linked grade attainment and repetition with growth retardation.

- In *Nepal*, Moock and Leslie (1986) found in multiple regression

that height-for-age was a significant determinant of grade attainment of children (controlling for age at enrolment).

- In *China*, Jamison (1986) found that a decrease of one standard deviation in height was associated with the loss of one third of a grade in primary school or 10 per cent of the years actually attained.

- In *Brazil*, a combined nutrition and pre-school education programme funded by the World Bank found modest improvements in growth (a decrease in malnutrition from 52 to 46 per cent in comparison with an increase from 44 to 47 per cent among non-participants) but significant improvement in school achievement—73.5 per cent passed first and second grade compared to 59.5 per cent among non-participants. The cost per second-grade graduate was US$442 for participants (including the pre-school programme) and US$494 for non-participants—once again a 10 per cent saving (World Bank, *Nutrition Reviews*, 1984).

- The *Bogotá, Colombia* study also revealed that children who had received supplementation or stimulation as pre-schoolers had lower grade-repetition rates.

Assuming that that 10 per cent inefficiency translates directly to fiscal savings, that primary school expenditures constitute half of total public education expenditures, and that 40 per cent of children are growth retarded, this would imply a two per cent saving in national education expenditures if all growth-retarded children were one standard deviation taller. This is clearly stretching the numbers far beyond realistic use; however, it does illustrate that if improved growth affects grade achievement and repetition rates it could have a significant effect on the economics of education either through fiscal savings or lowered cost per child promoted.

In summary, better growth is associated with better pre-school and school-age I.Q. It is also associated with learning-relevant behaviour, early enrolment in school and better school achievement, all of which enhance the educational efficiency of and economic return on primary schools. School systems in developing countries have serious inefficiencies irrespective of handicapped students, and these should also be rectified if one is to realize the full potential returns from improved child growth.

3. Health care resource use

Increased illness places a double burden on the health system: it increases the public and private costs of providing care and it contributes to deterioration of health status.

(a) Increased demands on resources. The costs to the health system and society of increased incidence, duration, complications, severity and mortality are considerable, including wasted resources in the case of death. Poor growth increases the total demand for curative services, it requires more expensive intervention (including more highly trained personnel, drugs, hospitalization) and has multiplier effects (through low birth weight and deteriorated nutritional status) for future demand. Given the overcrowding that occurs in most curative services, increased demand also reduces the quality of care and increases the private costs of obtaining it. Increased mortality brought about by the synergy between nutrition and infection constitutes a total loss of public and private investments in the child.

Clinical studies indicate that the immune system is progressively impaired with increased severity of growth failure. Poor growth of children—in weight and height—has a direct effect on prevalence of illness. Incidence of diarrhoea and respiratory disease is less affected than duration, severity and risk of complications (see Table 2). Partial recovery is possible upon refeeding severely undernourished children but very early deprivation (foetal and up to nine months post-natally) can result in long-term impairment of the immunological system.

Studies have shown that growth-retarded children (under 75 per cent weight-for-age) suffer a seven per cent increase in incidence of diarrhoea in Costa Rica (James, 1972) and a 25 per cent increase in rainy-season diarrhoea in Guatemala (Delgado et al., 1983).

Children less than 80 per cent weight-for-height showed a 47 per cent increase in incidence of diarrhoea in Nigeria. No increase in incidence was found in Bangladesh, however (Black et al., 1984).

Duration and prevalence are consistently higher in underweight children (less than 75 per cent weight-for-age): 23 per cent higher prevalence in El Salvador (Trowbridge et al., 1981), 32 per cent longer duration in Costa Rica (James, 1972), 33 per cent longer duration in Nigeria (Tomkins, 1981), 42 per cent higher prevalence in Colombia (Wray, 1978) and 56 per cent longer duration in Bangladesh (when comparing children less than 80 per cent weight-for-age against

those 90 per cent or greater, Black et al., 1984). This means the average bout lasts 10 to 14 days instead of 7 to 10.

In addition to duration, disease severity also increases with growth retardation. James (1972) found that 12 of 83 malnourished children but none of 54 normal children had to be hospitalized because of diarrhoea. Chen et al. (1981) did not find increased hospitalization rates for growth-retarded children in Bangladesh, however. Ghosh and Dhatt (1961) found that growth-retarded children had greater prevalence and number of complications of measles, and others have found that measles severity and mortality are directly related to nutritional status (*Nutrition Reviews*, 1968).

Diarrhoea and measles in addition to malaria and parasites exact their own high nutritional cost (Chen and Scrimshaw, 1983). Briscoe (1979) calculates that about six per cent of available food is lost to the body during infection. This results in reduced growth rates (Baumgartner and Pollitt, 1983), deterioration of nutritional status

TABLE 2

Effect of growth retardation on diarrhoeal morbidity (in per cent)

Country	Anthropometric cut-off	Change[a] in incidence	Change in duration	Change in prevalence
Costa Rica[b]	75% WA*	+ 7%	+32%	—
Guatemala[c]	75% WA	+25%	—	—
Nigeria[d]	80% WH*	+47%	+44%	—
	75% WA	0	+33%	—
Bangladesh[e]	80% WA vs. >90% WA	0	+56%	0
El Salvador[f]	75% WA	—	—	+23%
Colombia[g]	<85%	—	—	+42%

a/ Change in indicator of morbidity as a percentage of that normal-sized individuals (denominator is normal incidence, duration or prevalence).
b/ James (1972).
c/ Delgado et al., (1983), rainy-season data only
d/ Tomkins (1981).
e/ Black et al., (1984).
f/ Trowbridge et al., (1961).
g/ Wray (1978) used Mexican anthropometric standards; 85 per cent of Mexican standards approximately equal to third percentile USA.
*WA is weight-for-age, WH is weight-for-height.

relative to standards (Trowbridge et al., 1981) and absolute weight loss (Koster et al., 1981). Some of this nutritional stress is brought on by withdrawal of food from the child (Martorell and Yarbrough, 1983) but is also a result of malabsorption and metabolic losses. In the absence of adequate food intake during recovery, disease serves as a ratchet in the growth curve, relegating the child to a lower growth canal and increased risk of further disease.

Mortality is also higher in growth-retarded children, although growth retardation or undernutrition is rarely cited as the cause of death.

- In *Bangladesh*, children under 60 per cent weight-for-age (26 per cent of the study population) had almost twice the mortality rate within one year of measurement compared to children above 75 per cent weight-for-age.

- In *India*, children under 60 per cent weight-for-age (four per cent of population) had over four times the mortality risk of the overall population of children under 36 months of age.

Case fatality from measles is 40 to 50 times higher in least developed countries (LDCs) compared to the USA (*Nutrition Reviews*, 1968).

Another cost to the health system, often overlooked, is the impact of poor growth performance on reproductive efficiency in adult life. A chronically undernourished woman of low stature and adiposity is much more likely to give birth to a low-birth-weight infant that is at higher risk of illness and death. Such a woman needs more aggressive intervention during pregnancy (nutritional supplementation, increased surveillance, reduced energy expenditure compared to the non-pregnant state) if she is to have a larger baby.

Kennedy (1984) documented that in the USA mothers not receiving supplementation and health care during pregnancy gave birth more often to low-birth-weight babies, who then required a longer retention period in the hospital. Smaller babies may subsequently require more medical attention because of the increased risk of disease and mortality to low-birth-weight infants. Inadequate pre-natal nutrition and the low-birth-weight infant together contribute to a poor lactational performance, thus increasing the need for earlier supplementation and the associated risks of contamination. Efforts to improve lactation by supplementation during lactation in The Gambia failed

to increase milk supply while simultaneously increasing fertility of the lactating woman (Lunn et al., 1980; Whitehead et al., 1978).

Vision impairment due to vitamin A deficiency has long been recognized, but attention has recently been drawn to subclinical vitamin A deficiency as a cause of mortality and morbidity. Two studies in Indonesia have been used to argue that vitamin A-deficient children suffer two to three times the incidence of respiratory disease and diarrhoea (Sommer, Katz and Tarwotjo, 1984), that 16 per cent of all deaths are due to vitamin A deficiency (Sommer, Hussaini, Tarwotjo and Susanto, 1983), and that vitamin A supplementation can reduce mortality by one third (Sommer, Djunaedi, Loeden, Tarwotjo, West, Tilden and Mele, 1986). Severe vitamin A deficiency does cause growth retardation and defects in the protective epithelial layer of the lungs and gastro-intestinal tract, so these effects of subclinical deficiency are not unlikely. The research design and analysis of both studies are flawed, however, which suggests caution should be exercised in implementing vitamin A supplementation as a means of reducing morbidity and mortality. No evidence outside of Indonesia exists on either costs or effectiveness. Ongoing programmes in Malawi and Bangladesh should provide further elucidation of this kind of effort as a feasible option for promoting healthy growth of children.

(b) Resource savings. The health sector savings introduced by improved child growth include the cost savings of reduced hospitalizations and sick child visits, reduced demand for antibiotics and other drugs required for late emergency treatment and reduced demand for more highly trained personnel. To the extent that preventive care (growth promotion) substitutes for curative care, improved growth would reduce costs per health visit and reduce the demands for highly trained personnel. Since most preventive care services are underutilized in LDCs (Akin et al., 1985), increases in demand for preventive care would introduce increased efficiencies, particularly cost per client.

The private cost savings to individuals include reduced expenditures for drugs, other cures and medical services and for the transport and associated costs of obtaining medical care, reduced loss of income if productive members of the household stay home with the sick child, and increased productivity of children either through reduced school absenteeism and/or increased labour of the child.

To the extent that they translate into either increased savings, income or productivity, these private benefits would also contribute to national economic growth.

Good data on costs are difficult to find. Budgetary costs and consumer prices are clearly only partially representative of true economic costs. Based on a recent summary of known budgetary costs of health services (Robertson, 1985), it is clear that hospitalization is far more expensive than outpatient care (by a factor of two to 20), and preventive services cost less than curative services (see Annex 2). It is impossible, based on Robertson's data, however, to calculate the net returns to growth promotion. However, the Kennedy data cited earlier suggest that in the USA sizeable savings are possible from a preventive approach. For every US$1 spent on pre-natal supplementation and health care US$3 of hospitalization costs for pre-natal intensive care could be averted by reducing the incidence of low-birth-weight babies.

To assume that utilization of maternal-child health services is required to bring about adequate growth and that the reduction in demand for curative services will be matched by a proportionate increase in demand for preventive services may not be valid. On the first point, growth promotion is possible through a number of channels which may or may not require public sector health service. In Indonesia, for instance, it is community-based and linked to a population programme. Second, the demand for preventive services is universally low in the absence of incentives like public education and motivation, reducing the price of services, increasing their availability and effectiveness, and reducing private costs of utilization.

Humanitarian rationale

The moral imperative of caring for children has been well articulated by UNICEF, so we only highlight a few points. Regardless of economic costs and benefits of improved growth, it is morally incumbent upon society to care for those members who cannot look out for themselves. In a sense, the quality of the next generation is a public good, for children are the future of all societies.

In light of the fact that adequate resources exist and feasible technology is available to assure satisfactory growth of all normal children, it is doubly repugnant that 40 per cent of children are not growing properly. One can consider adequate nutrition and health care as basic human rights; a child's existence creates entitlement.

If the poor are so preoccupied with the present and survival that they cannot afford to invest in the future, then society at large must promote investment in poor children. No one consciously deprives a child of sustenance, but unconscious actions responding to severe family and community resource constraints may cause growth failure in children. Alleviation of poverty will take too long for the needs of the next generation, so direct intervention is often the only answer. People are the 'ultimate resource' for progress but clearly the quality of human resource is the keystone—if half the population is mentally and physically weakened by early childhood deprivation then society has squandered its potential.

Political rationale

One of the most appealing aspects of promoting children's growth is that it affects everyone, regardless of income level, race or geographic location. In the West, it is the advantaged sectors of the population who monitor children's growth through frequent paediatric visits. Families benefit to the extent they are at risk—well-to-do people need only reassurance that their children are growing properly, but poor people get counseling and perhaps some complementary resources to guarantee that their children do not become growth-retarded. The universal appeal of growth promotion broadens the base of political support and provides a link between the well-to-do and the poor. Malnutrition, usually only a poor people's problem, fails to capture long-standing public support because guilt rather than self-interest is often the reason for concern. Given the right communications strategy, growth promotion can become all of society's concern.

A second selling point of growth promotion is that it is positive. Success is determined by actual improvements in children's welfare rather than negatives (like mortality, births averted or disease incidence). The ability to built a positive campaign is vital to garnering long-term support from those who have tired of negativism.

Another positive aspect of growth promotion is the multiplicity of means available to accomplish the goal. There is no single intervention that must be undertaken. Because growth retardation is caused by a number of factors, public and private strategies can be joined to maximize local strengths and weaknesses. This also means that no government ministry automatically takes control; respon-

sibility should be given to the ministry or office with the greatest political and institutional strength. Bureaucratic inertia and budget conflicts tend to kill new initiatives because they threaten the status quo. All relevant ministries should have the opportunity to contribute to the overall goal of child growth and development. If the public health system is inadequate, the growth promotion does not have to wait until the health system functions—perhaps it can use the schools or traditional health providers. There are a number of components that ultimately should be included, but they can be added sequentially as the system is able to absorb them. Many of the necessary growth promotion interventions, immunization, for example, create opportunities for highly visible mass mobilizations, which can serve as the foundation for self-sustaining efforts.

Because growth failure occurs most broadly among the poor and rural populations, growth promotion offers an opportunity to close the gap between social classes, which tends to widen, at least in the short term, with economic growth. Growth promotion offers the same political advantages of other public welfare programmes yet provides better quantitative evidence of impact in the form of growth data.

Growth monitoring constitutes a rational and comprehensive means for targeting resource transfers as well. All too often, potential recipients are not aware of the reasons why they are or are not entitled to certain benefits. This misunderstanding breeds resentment and distrust of the government. Using children's growth as a trigger for programme action makes more sense than some statistical construct like 'risk'. At the same time, growth monitoring in particular does not relegate all interventions to curative ones—it is inherently preventive because it detects incipient problems. Finally, growth monitoring is satisfying to parents, for it provides to them immediate feedback—particularly that they are doing well. All too often the key decision maker, the parent, is left out of diagnosis, problem solving and evaluation of his or her own child's problems.

A final important political payoff from growth promotion is the potential for rapid results. Once a system is in place, if it includes weighing children, positive results can be seen in less than a year. It is also one of the main justifications for promoting growth—infants and toddlers respond very rapidly to beneficial (or detrimental) conditions: they are 'vulnerable'.

Growth promotion action areas

The underlying cause of growth retardation is poverty, and hence some sort of resource transfer to the family is often required—food, employment, public services or cash. At the margins, however, reallocation of existing family and community resources may effect some improvement in growth, especially over the weaning period from 6 to 36 months of age. UNICEF's programmatic strengths and priorities complement structural change and large-scale poverty alleviation efforts but in no way should be seen as a substitute for actions to address the more basic poverty problem.

Growth retardation can begin *in utero* due to maternal malnutrition and illness, giving rise to low-birth-weight babies. Subsequently, growth faltering begins most frequently at about four to six months of age. It is caused by several simultaneous stresses on the child at that time.

- The breast-fed baby is given regular food which is probably contaminated, of low nutrient density, of poor nutritional quality and given in insufficient amounts with too-low frequency.
- The baby becomes mobile and starts putting everything in its mouth—introducing heavy doses of pathogens, particularly fecally transmitted organisms.
- The child begins teething, which may cause fever (and resulting remedies which carry health risks), encourages rejection by caretakers because of incessant crying, and frequent signals a new social role for the infant (generally less attached to the mother).

At weaning from the breast the child is further stressed nutritionally and distanced from the mother. The child may experience depression which exacerbates health and behavioural problems (Cassidy, 1980). Growth promotion, to be effective, must take into account more than simply the biological determinants of growth—it must also take into account behavioural and cultural factors.

The multiple aetiology of growth retardation dictates that various

programmatic actions are required. This has the advantage, stated earlier, of giving flexibility and increasing options; different intervention configurations can be devised to fit the particular circumstances prevailing in specific countries. All growth interventions do not have to be administratively integrated; that frequently exceeds managerial capacity. It is important, however, to view the various actions with an integrative perspective which recognizes the need for actions in several areas and the links among them. This is essential to counteract three implementation risks. First, huge efforts on one intervention, e.g., immunization, can crowd out the other needed actions; financial resources and political capital can be overspent on one leaving too little support for others. Second, the 'easier' interventions will dominate the more difficult, albeit critical, interventions. The degree of technological, organizational, economic or political difficulties can vary across intervention type as well as country situation. Third, thinking vertically rather than integratively may result in missed opportunities to increase effectiveness by failing to capture the synergies possible by co-ordinating and linking multiple actions. Of the various growth promotion action alternatives we will now examine, the first two—motivational communication campaigns and growth monitoring—appear particularly important in contributing to this unifying and integrative perspective.

Motivational campaigns

It has been shown repeatedly in field studies as well as interventions that social norms and parental behaviour can contribute to growth failure: leakages and diversions of food supplements, failure to follow through on educational messages, lack of stimulation of infants, underutilization of preventive health care services, to name a few. Of course, some of this disinvestment in children is due to ignorance or to total resource constraints (particularly time), but we have good evidence that parents are very rational in their behaviour. They weigh the costs and benefits of spending their time, energy and income on different household activities, and as a result children often suffer. Especially where infant and child mortality is high, it may not seem worth while to invest scarce resources in young children. High risk then becomes a self-fulfilling prophecy. Parental behaviour is also culturally rational. The norms of children's behaviour, physical activity and size are often determined in response

to historical as well as immediate ecological stresses. Promoting bigger, healthier children may not fit in with the socio-cultural milieu (Cassidy, 1980).

To promote children's growth, we must provide information, resources and rational justification for this goal. This requires motivational messages to persuade parents to help their children grow better, as well as necessary changes in economic and social systems to make sure that parents benefit from the change. It is vitally important to include both parents in the motivational campaign. Even though the mother may feed the child, attend to health needs and assume all child-care responsibilities, it is often the father who determines whether the child goes to school or a woman gets pre-natal care. Sometimes grandparents play a key role as well. It should be a family-based campaign. The well-tested principles of social marketing should be used to create the most effective messages. The power of modern communications technologies can be effectively deployed.

Governments underinvest in children as well: immediate fiscal priorities take precedence over future investments. As was shown above, however, investments in agricultural research, industrial capacity and higher education require complementary investments in human resources to achieve goals. The foundation of human resources is established in early childhood growth and development, and failure to build this foundation is only partially remediable (at greater cost) after the pre-school growth spurt.

So the first priority of any government interested in growth promotion should be to raise social consciousness about the importance of children's growth to the nation's future. As a campaign, it is very appealing to garner initial support among élites, politicians and bureaucrats. Ongoing efforts to reinforce the message will be needed to change social norms and family behaviours. These messages should be informational as well as motivational and tied into growth promotion interventions. They should cover nutrition, primary health care, psychological stimulation, child care, child spacing and motor development. The child's life should be covered from conception to three years of age.

Growth monitoring

Although it is possible for the child population to grow better without it, growth monitoring enhances efficiency of, participation

in, and feedback from the process. Growth monitoring is much more than a weight chart; it is a means of long-term, two-way communication between parents and a trained growth promoter. The efficiencies it introduces include improved targeting of resource transfers, better timing of intervention (hence allowing lower cost), customizing and restricting information transfer to the specific child (hence increasing receptivity), and serving as a focal point for the multiple public services that affect children's welfare (improving outreach and access). Growth monitoring increases community participation when information on its children's growth performance is displayed publicly (Griffiths, personal communication). It can also improve participation of parents in promoting the growth of their children with their own resources as well as those available from public programmes. Feedback from growth monitoring is most important for the parents—so they know how well they are doing with their child—but it is also possible to use growth data at the local and national levels to document change in basic welfare, to evaluate programme impact, to target development programmes geographically, or possibly as an early warning system (as is done in Botswana). The top priority must remain communication with parents, however, since other uses of growth data drain away resources from the primary purpose of growth promotion.

Although growth monitoring has been around for 25 years, it has not been objectively evaluated. The best growth-monitoring programmes (Indonesia and Tamil Nadu, India) are recently implemented, but preliminary results indicate that growth monitoring can improve nutritional status at low cost (Zeitlin et al., 1984; Martorell, 1986; Gwatkin, Wilcox and Wray, 1980; Ho, 1985). Very large projects have been successfully carried out in both Indonesia and Tamil Nadu. They are now being expanded to the state level in India. Cost data, as usual, are inadequate, and one would expect that pioneering projects would be more expensive than national replicates. A particular complication with economic analysis of growth monitoring is that it is usually part of a package of services, and disaggregating its component from overall programme costs is difficult. Cost data available for the recent World Bank-funded projects in India and Indonesia (Ho, 1985) indicates total annual costs per capita in project areas were US$0.98 in Indonesia and US$0.49 in India for weighing, feeding and nutrition education. Both of these projects build on existing infrastructures of village-level workers,

and it is not clear whether these costs include those of volunteer personnel.

The impact on nutritional status in Indonesia was a reduction of Gomez II and III (under 75 per cent weight-for-age) from 19.4 per cent in 'control' villages (which actually had an ineffective government nutrition programme) to 10 per cent in intervention villages. In India the pilot area experienced a 0.3 per cent increase (to 19.1 per cent) of 'Grade III and IV' malnutrition while the control village increased 2.9 per cent (to 19.3 per cent of all children seven to 36 months of age). Statistical significance is not reported.

Gwatkin, Wilcox and Wray (1980) found costs of nutrition monitoring in conjunction with medical care to cost US$0.40 and US$1.50 per capita in Jamaica and Nigeria, respectively.

Nutrition education accompanying growth monitoring is an integral part of growth promotion. It provides information and motivation for behavioural change necessary to prevent or ameliorate growth retardation. Nutrition education has not been successful historically in the absence of additional resource transfers to effect changes. Where the physical resources required are small (as in feeding during weaning) opportunity costs of changed practices may be more relevant than financial constraints (Hornik, 1985). Recent advances, however, in message content and design as well as use of mass media show promise for the future (Manoff, 1982).

One major difference between 'new' nutrition education and traditional types is that the former does not presume to know the correct message a priori. The basic four food groups have demonstrated their ineffectiveness as a core message. New efforts devote a great deal of research in advance to determining local perceptions of problems, behavioural determinants of growth retardation, and willingness and ability to try new practices. In addition to improved messages, recent nutrition education efforts have used well-conceived and sophisticated communications strategies that make optimal use of mass media, print and interpersonal communications.

Hornik cites cost-effectiveness of three successful nutrition education efforts, two of which were tied in to other services. A Moroccan supplementary feeding programme that added nutrition education reduced growth retardation by two thirds (from 30 per cent to 10 per cent) at US$2 per family reached. An Indonesian nutrition education project without other programme inputs reduced growth retardation by 50 per cent at a cost of US$2 per child exposed to

the programme. In the Philippines, a nutrition education programme to improve weaning foods cost about US$20 per adopter (US$3.35 per participant). Much better cost-effectiveness data are needed on nutrition education before its relative merits can be calculated. There is little doubt, however, that the best current methods of nutrition education should be combined with growth-monitoring activities.

Nutrition education cannot, however, compensate for total resource constraints. For that reason growth monitoring should be tied to resource transfer programmes (health care and supplementary feeding programmes, usually) and should be linked to reducing or spacing out resource requirements through child spacing. Nutrition education is especially valuable when additional resources are available because it helps optimize utilization.

There are other interventions, less directly tied to children's growth, which have been shown to improve growth performance and should be considered as part of a growth promotion strategy. These will be covered only briefly since recent reviews have examined costs and effectiveness (for instance, Austin and Zeitlin, 1981; Kennedy and Alderman, 1985; Feachem et al., 1983-86; Halpern and Myers, 1985). They fall roughly into four categories: food and other resource transfers, health, child spacing, and child-care behaviour.

Food and income interventions

Food intake is but one determinant of growth, and availability of food to the household is but one determinant of food intake. Hence, efforts to increase household food supply or food designated for children (through supplementary feeding programmes) have not uniformly resulted in improved children's growth. Feeding programmes have shown little effect on growth (Beaton and Ghassemi, 1982; Feachem, 1983), although controlled supplementary feeding studies have generally been successful in promoting growth. The quality of project evaluation is usually poor, and it is possible that real gains were not detected. Supplementary feeding of pregnant women, on the other hand, has been shown to have significant effects on birth weight (Ashworth and Feachem, 1985). The monetary and institutional cost of feeding programmes is high, particularly relative to effectiveness. It is probable that linking supplementation with growth monitoring improves both cost (due to decreased numbers receiving supplements) and effectiveness (due to the monitoring and counselling) of feeding programmes.

Food subsidy and income transfer programmes have generally been shown to increase intake of poor households, but the cost can be high and untargeted food supplies tend to be regressive (Behrman, 1986; Kennedy and Alderman, 1985). The frequent result is net transfers from the rural to urban sector and from farmers to non-farmers. Few studies have attempted to link subsidized consumption or food rations with children's growth performance.

- The *Kerala, India* food rationing programme had a positive effect on growth of children (Kumar, 1979).
- A reduction in moderate to severe malnutition was also found in the *Philippines* (Garcia, 1984). In that case, subsidies appeared to reduce growth retardation of pre-school control villages but the provision of nutrition education had mixed effects on subsidized and unsubsidized villages.
- No growth effect was found of a ration programme in *Pakistan* or a milk subsidy scheme in *Mexico* (Kennedy and Alderman, 1985).
- Isenman (1980) attributed a rise in overall mortality in *Sri Lanka* in 1974 from 7.7 to 8.9 per 1,000 to cuts in the food subsidy programme; however, further research has failed to confirm his findings.

To increase the effectiveness of subsidized consumption, improved targeting by income class, season, geographic region or commodity would be required, but that often entails challenging entrenched political and bureaucratic interests. With respect to growth promotion alone, food subsidies are undoubtedly very high-cost, although they may convey other benefits to the family. In a recent World Bank review, the two subsidized consumption programmes were four to eight times as expensive as the comprehensive growth-monitoring programmes, with unknown (but probably lower) effectiveness.

Great hopes have been pinned on advances in agricultural technology as a means of addressing undernutrition; however, there is no evidence that increased food production automatically results in better growth of children on a family, regional or national level (Kennedy and Alderman, 1985; Goldman and Overholt, 1981). Food availability must be matched by purchasing power and motivation to translate into improved growth. Efforts to improve employment

and wages of the poor must go hand in hand with agricultural production efforts.

Breast-milk is one food for which an increased supply provides an unequivocally positive effect on growth of children. Notwithstanding the debate on differences in growth patterns between breast-fed and non-breast-fed infants, it is clear that the functional effect on the growth of breast-fed children is reduced morbidity and mortality (Feachem and Koblinsky, 1984). Its impact lies as much in its nutritional quality and immunological properties as in its non-contamination with disease pathogens, and it is the original, self-targeted food. Improving breast-milk availability on a community scale is a matter of promotion and supportive services. Doing so on an individual basis is another matter, particularly where the problem is not initiation of breast-feeding but adequacy. Maternal malnutrition seems to reduce milk quality, but supplementation during lactation has had mixed results. In The Gambia, supplementation during lactation not only did not increase breast-milk output, it decreased prolaction and increased fertility (Lunn, 1980). The Gambian investigators were successful in increasing breast-milk supply indirectly—through supplementing the pregnant women, they increased birth weight, and heavier babies were more competent at extracting a greater milk supply (it may also have been due to increased maternal stores after pregnancy, Prentice et al., 1983; Whitehead et al., 1978). One example (almost anecdotal) from Guatemala has shown that supplementation during lactation can improve milk supply (Sosa, 1976). Given the efficiency with which maternal intake is converted to breast-milk (about 90 to 100 per cent), the cost-effectiveness of promoting growth through promoting pregnancy weight gain would be equivalent to that of growth monitoring cum supplementary feeding. The cost-effectiveness of social marketing campaigns to improve breast-feeding is unknown. We know of no valid cost and impact data from such promotional campaigns (Tognetti, n.d.).

Since growth retardation generally starts at weaning, the development of appropriate weaning foods is often proposed as a solution. These foods can be made in the home (including improvements on traditional gruels through addition of oil, green leaves or protein) or non-home production by community or commercial means. Manufactured products are also available through food aid programmes for children (corn-soy-milk and wheat-soy-blend). Wean-

ing foods can be prepared by the target group itself using resources available in the home or they can be processed foods distributed commercially, at subsidized prices, or given away at no charge. The key problem with implementation appears to be motivation and education rather than the food processing itself. If the food is processed industrially, costs can be prohibitive either to the poorer consumers (if distributed commercially) or to governments (if subsidized or distributed free). Processed weaning foods may also be less accessible to rural consumers because of flaws in the marketing system or reliance on subsistence agriculture (Kennedy and Alderman, 1985).

- Zeitlin (1981) found that a locally designed nutrition education programme in *Burkina Faso* to promote home-based weaning food production cost US$0.29 per participant (including a health care package) and effected a reduction in malnutrition (under 75 per cent weight-for-age) from 35 to 12 per cent compared to a village with an ineffective weaning programme.

- Manoff and Associates were able to improve nutritional status of children under three in *Indonesia* with a nutrition education programme designed to encourage breast-feeding and to improve the weaning food by adding fat green leafy vegetables. The project had a projected annual cost of US$2.05 per beneficiary (if expanded to a national scale). It reduced malnutrition (less than 75 per cent weight-for-age) from 35 to 15 per cent among children nine to 23 months of age (Manoff International, Inc., 1984).

- A *Philippines* weaning education programme (Ashworth and Feachem, 1985) showed a reduction in malnutrition (under 75 per cent weight-for-age) from 64 to 42 per cent at a cost of US $9.60 per participant.

Health Interventions

The efficacy of certain health measures to ensure child *survival* is well recognized. UNICEF estimates that in 1986 alone immunizations and oral rehydration therapy saved 1.5 million lives, and that over one half of the 14 million annual child deaths could be prevented through these measures. Rarely, however, have immunization campaigns and ORT programmes been evaluated for growth outcomes.

Ironically, to the extent that they reduce mortality, they may appear to worsen population-level growth performance statistics since survivors who would have died are probably the most growth retarded. The toll that infections take on nutritional status is well documented (Chen and Scrimshaw, 1983; Mata, 1978; Martorell, 1975). Diarrhoea, measles, and febrile illnesses in general cause weight loss through metabolic inefficiencies, reduced intake and increased losses (especially with diarrhoea). Therefore it makes sense that control of infectious disease would positively affect growth. This logical relationship has not been demonstrated in intervention programmes, however.

- A three-village study in *Guatemala* found that the 'health care' village showed no difference in children's growth performance compared to the control village, but the nutrition village showed significantly better growth (Scrimshaw, Guzman, Flores, Gordon, 1968; Gordon, Ascoli, Mata, Guzman and Scrimshaw, 1968; Guzman, Scrimshaw, Bruch, Gordon, 1968). On the other hand, multi-variate analysis of growth in one of the villages (Mata, 1978) found that the incidence of several enteric diseases contributed significantly (20.4 per cent of variance) to growth retardation, while calorie intake had a weaker association (4.7 per cent of variance).

- In *Narangwal, India*, much the same evidence was shown. The nutrition and health care village showed significantly improved growth performance compared to the control village, but it was not far ahead of the 'nutrition only' village. Health care without nutrition was no different from the control village with respect to children's growth.

- A study in *Cali, Colombia* (Koopman, Fajardo and Bertrand, 1980), found that food availability had a weaker relationship to growth retardation than environmental sanitation.

Briscoe (1979) estimates that intestinal parasitic infection, in the absence of diarrhoea, is unlikely to be a major source of nutritional loss. Yet a study in Kenya found that anthelminthics increased fat folds of children (*Nutrition Reviews*, 1981).

It is possible to treat parasitic infections that are a cause of growth retardation with eradication (in the case of malaria and schistosomiasis), deworming, or water supply and sanitation. Particularly

for diarrhoeal pathogens, water supply and sanitation is important. An evaluation of the recent World Bank water and sanitation project in Colombia showed that for every 10 per cent increase in houses with latrines, child malnutrition was reduced by 15 per cent (*Nutrition Reviews*, 1984). Unfortunately, parameters of malnutrition were not described and costs were not given. Esrey, Feachem and Hughes (1985) recently reviewed six studies on the impact of water supply and sanitation on growth performance of pre-school-age children (see Table 3). From their data it appears that improving quality and availability of water and sanitation reduced growth retardation by six to 10 per cent in Bangladesh, while sanitation alone reduced it by five to 28 per cent in Fiji and Colombia; increasing availability alone decreased it by 38 to 44 per cent in Nigeria and St. Lucia, and increasing availability and sanitation decreased growth retardation by 19 per cent in St. Lucia (different cut-offs of weight-for-age were used to determine growth retardation).

Costs of rural water supply programmes were estimated to be about US$10 per capita per year; rural sanitation programmes cost US$4 per capita.

TABLE 3

Impact of water and sanitation programmes on children's growth

	Intervention[a]	Growth cut-off point (weight-for-age)	Reduction in growth retardation
Bangladesh	Q+A+E	75%	6-10%
Colombia	E	90	28
	A		37
Fiji (urban)	E	% standard	2 percentage point loss
(rural)	E		7 percentage point loss
Nigeria	A	75	38
Philippines	Q+A	75	7
St. Lucia	A	90	44
	A+E		19

Source: Esrey, Feachem and Hughes (1985).

a/ Q = quality of water; E = excreta disposal; A = availability of water.

Child spacing promotion

Many believe that short birth intervals (less than two years) adversely affect growth, morbidity and mortality risks of the children on one or both ends of the interval (Winikoff, 1983; Huffman, 1984). Although short interbirth interval has been shown to increase infant mortality (Trussell and Menken, 1984; Chandler, 1985), there is much less evidence of interval effects on growth. Birth weight is adversely affected by very short intervals (under eighteen months) (Ashworth and Feachem, 1985). Zeitlin et al. (1982) found that birth interval was a key determinant of growth performance and morbidity in Ghana. Wray and Aguirre (1969) found that rates of malnutrition were twice as high in children spaced less than two years apart compared to those more than three years apart. In one study in Guatemala (Russell, 1976) it was found that height increases as birth intervals lengthen, particularly for males. The author attributes this effect to constraints on parental time and breast-feeding when births are too close together. The interrelationship between birth spacing and breast-feeding is worth highlighting. Early cessation of breast-feeding hastens the return of fertility. Early conception in spite of breast-feeding (which has a fertility-reducing effect) tends to accelerate weaning, and early weaning by itself has growth-depressing effects where contaminated and inappropriate weaning foods are used. In Mata's study of Santa Maria Cauque (Mata, 1978), birth interval was found to be an important determinant of growth velocity, particularly after early infancy, explaining 5.5 per cent of the variation in growth.

Cost-effectiveness data with respect to child spacing are almost non-existent. A recent review of cost-effectiveness methods in population programme analysis does not even include interbirth interval as a measure of programme achievement (Salkever and Sirageldin, 1983). If we assume one couple year of protection (CYP) approximates the outcome of interest and the intervention is social marketing or promotion, the cost after two to three years varies from about US$2 per CYP in Colombia, India and urban Thailand to about US$5 in Jamaica, Sri Lanka and rural Thailand (Gillespie, Mamlouk and Chen, 1983). If each couple year of protection were used to extend the birth interval from 18 to 23 months up to 30 to 35 months, the effect on growth retardation (using Russell's Guatemala data) would be about 14 per cent of one standard deviation in height (which probably underestimates the change in weight-for-age). If we use Wray and Aguirre's figures from Colombia, increasing birth spacing

from under two to three or more years brings about a 50 per cent reduction in growth retardation. (This estimate is probably too high since the authors did not control for many intervening variables.)

Child-care behaviour

Because the growth and development of the child is strongly influenced by the quality of the interactions between parents (or other care-givers) and child, it is appealing to consider parenting education and child care as interventions to promote growth. Some aspects of care-giving (for instance, breast-feeding promotion and health behaviours) are dealt with elsewhere. Other interventions can include maternal tutoring, CHILD-to-child programmes, early childhood education programmes, or even simply child-care services for working mothers. One study found that it was possible to change parent-infant interaction by supplementing the child pre- and postnatally (Chavez, Martinez and Yaschine, 1985). This altered behaviour of parents and child contributed (in unestimated ways) to improved growth and development of Mexican children. The Puno project in Peru (Myers et al., 1985) found that a community-based pre-school programme had an impact on growth of children with quite modest nutritional inputs. In Bogotá, Colombia, maternal tutoring even without nutritional supplementation had a positive effect on height-for-age and weight-for-age at age seven (Halpern and Myers, 1985). In the Bogotá pilot study (Christiansen et al., 1974), the investigators found that well-nourished children differed significantly from malnourished children in self-reported frequency of mother play, praise, maternal vs. sibling child care, and teaching efforts. The Cali data suggest that cognitive stimulation had an additive effect on growth beyond that of nutrition and health (Bejar, 1981, fig. 1).

A long-suspected relationship between sibling child care and younger sibling growth has some support from field studies, but no information exists on whether organization of more formal child care (anything from training grandmothers to local day-care centres) has any better effect on child growth (Engle, 1980, 1986) and, if so, at what cost. Yet this option has strong appeal, particularly where women leave the home to work (including agricultural work in their own fields).

Current research on positive deviance (Zeitlin, 1986) and personal communication in Bangladesh is attempting to introduce new child-care technologies and feeding and hygiene practices as means

of improving child growth. Behavioural research and trials like this will provide much-needed information on the costs and feasibility of changing child-care-giving micro-behaviours that contribute to growth failure.

Integration considerations

It is commonly espoused that integrated interventions are superior to vertically integrated services. While this is appealing in theory, the practical difficulties have generally meant one component dominates the overall project or the package fails altogether. Wray attributes this failure to the 'skinny Hercules' phenomenon: some poor, illiterate, unpaid village worker is expected to manage six different programmes for his or her community. The problem springs from attempting too much too soon. The Indonesian experience of building up a successful family planning programme and then adding other elements (growth monitoring) makes sense. Certain programmes naturally integrate together: psychosocial stimulation and nutrition, preventive and curative health care, growth monitoring and nutrition supplementation, and child spacing and health care. The most important determinant of whether to integrate is institutional capacity. Formal integration (joint management) may not be necessary, if some management entity has oversight and power to initiate new free-standing activities. In this way, programmes can be conceptually integrated but different actors can be involved in implementation of virtually independent programmes. With respect to growth promotion it would make sense for the overall campaign to be executed centrally—especially motivational communications. Component parts would be initiated based on differential interest and capacity in ministries and the private sector and on local demand.

Further research

Sufficient evidence exists to argue for children's growth promotion as a priority matter in national development, and existing experience indicates promising areas of intervention. There is no excuse not to take action. In the near future, however, it would be extremely useful to carry out research in three principal areas: growth linkages, parental behaviour and implementation experiences.

Growth linkages

There is insufficient empirical evidence on two types of growth linkages: the determinants and the consequences of growth.

- *On the determinants side*, while the contribution of nutrition programmes on growth has been intensively studied, relatively little is known about the growth-promoting effects of health, population, education and resource transfer programmes. With the great emphasis on child survival, the quality of life of survivors may be relatively neglected. In evaluations of child survival interventions, including child spacing, the effects on growth should also be documented.
- *On the consequences side*, there is a need to ascertain more clearly the carry-over effects of childhood growth on adult performance in terms of physical capacity, cognitive dysfunction, illness propensity, work loss and reproduction. All of these linkages carry significant economic implications, yet causality is difficult to establish due to the multitude of intervening variables.

Parental behaviour

Knowledge is inadequate about the causes and consequences of parental investment in children, although parents devote far more resources to children than public services ever will. Growth retardation is explained by more than poverty alone because half of poor

children grow adequately. Much of this difference may lie in parental behaviour and priorities. 'Investment goods' for children include food, health care, education and clothing but go beyond economic commodities. In particular, parental energy, time and attention are needed. An often neglected input into child growth and development is psychosocial stimulation by parents and other caretakers. More analysis of psychological, marketing, anthropological and economic factors is needed to identify opportunities for reorienting parental investments towards *quality* of children. Lessons from family planning interventions that seek to reduce *quantity* of children may provide complementary analysis. Field tests of new concepts should be attempted as part of growth promotion activities. Further studies are needed of positive and negative growth deviants within the same economic group to determine how much growth retardation is caused by resource constraints and how much by behaviour within these constraints.

Implementation experiences

One of the types of research that can accelerate programmatic action is the documentation of country experiences with growth promotion strategies and interventions. Policy makers and programme managers are concerned about what will work; they listen more to field results than theoretical arguments. These country and programme studies should be sufficient in number to discern patterns and permit generalizations. The studies should focus on three aspects. The first is the strategy formulation and political mobilization process. Eliciting political commitment is a prerequisite of effective implementation and is not well studied. The second is the organizational and managerial aspects of carrying out specific growth interventions and dealing with the co-ordination and integration issues. The third is a documentation of the cost-effectiveness of the various growth promotion interventions. A recent review of early childhood interventions for the World Bank (Myers and Hertenberg, 1986) found that such projects can have good benefit-cost ratios but that absolute costs are also high. The spectrum of Latin American and Caribbean programmes they reviewed cost from US$8 to US$272 per child per year, up to half of which was contributed by the community. There may exist resource thresholds, that is, minimum programme outlay levels that must be surpassed in order to have a significant impact

on growth; allocations below these levels may be too small or spread too thinly to achieve impact. Further cost-effectiveness data must be collected to ascertain this phenomenon.

The existing global data base needs to be amplified. Such applied research could be accompanied by a strategy of information dissemination among key decision makers and programme implementers throughout the world.

The major challenge of the future is to move beyond child survival. The pursuit of growth is the goal; unlocking children's potential is the task. Investing in childhood growth makes economic sense; it accelerates national development. Growth promotion strategies constitute an economic gain, a humanitarian imperative and a political asset. Growth promotion strategies are financially and technically feasible. UNICEF is uniquely positioned to assume a major leadership role in mobilizing global support for growth promotion.

Annexes

ANNEX I

Nutrition and productivity (in per cent)

GUATEMALA

	Lean body mass	VO_2 max.	Max. work (kg-M)
Cadets	100	100	100
Supplemented peons	94	89	94
Recruits	87	85	89
Peasants	89	74	81

Source: Viteri (1971).

COLOMBIA

	Lean body mass	VO_2 max.
Normally nourished	100	100
Mild malnutrition	78.8	72.6
Intermediate malnutrition	71.4	57.2
Severe malnutrition	66.5	35.1

Source: Barac-Nieto et al., (1978).

	Lean body mass	VO_2 max.	Tons sugar day
High-productivity sugar cutters	100	100	100% (4.45T)
Medium productivity	93	89	82%
Low productivity	89	81	59%

Source: Spurr et al., (1977).

INDIA—agricultural labour of boys

Nutritional status at age 5	Lean body mass	Physical work capacity at 170 heart rate	Agricultural wage rate
Normal > -2Z	100	100	100
Mild -2Z — -3Z	85	88	100
Moderate -3Z — -4Z	83	84	82
Severe < -4Z	68	56	82

Source: Satyanarayana (1979, 1980).

ANNEX I

Nutrition and productivity (in per cent)

GUATEMALA—Present value of lifetime earnings up to age 62

	In terms of sugar delivered/day	In terms of gross earnings
Tall cane cutter	US$6,577	US$7,400
Short cane cutter	6,326	6,378

Source: Immink, Viteri, Flores and Torun (1984).

ANNEX II

Health service costs (in U.S. dollars)

Thailand		
Cost per service contract	District hospital	$ 1.73
	Subdistrict health centre	0.61
	Midwifery centre	0.63
Colombia		
Cost per six months	Paediatric hospital discharge	19.7
	Growth programme	7.9
	Health post	3.9
	Emergency care	0.8
Brazil		
Cost per ambulatory unit		3.41
Cost per hospital release		85.95

Source: Robertson (1985).

References

Akin, J. S., D. K. Guilkey, C. C. Griffin and B. M. Popkin. 1985. *The Demand for Primary Health Services in the Third World.* Totowa, N.J., Rowman & Allanheld.

Ashworth, A. and R. G. Feachem. 1985. 'Interventions for the Control of Diarrheal Diseases Among Children: Prevention of Low Birth Weight', *Bulletin of the World Health Organization*, vol. 63, pp. 165-184.

Austin, J. E. and M. F. Zeitlin, eds. 1981. *Nutrition Intervention in Developing Countries* (Cambridge, Mass., Oelgeschlager, Gunn and Hain, Publishers, Inc.).

Austin, J. E. 1980. *Confronting Urban Malnutrition* (Baltimore, Johns Hopkins University Press, Tables 2-1, 2-2, pp. 12-13).

Balderston, J., A. Wilson, M. Freire and M. Simonen. 1981. *Malnourished Children of the Rural Poor, The Web of Food, Health, Education, Fertility, and Agricultural Production* (Boston, Auburn House Publishing Company).

Barrett, E. and M. Radke-Yarrow. 1985. 'Effects of Nutritional Supplementation on Children's Responses to Novel, Frustrating, and Competitive Situations', *American Journal of Clinical Nutrition*, vol. 42, no. 1, pp. 102-120.

Basta, S. S., M. S. Koekerman, D. Karyadi and N. S. Scrimshaw. 1979. 'Iron Deficiency Anemia and the Productivity of Adult Males in Indonesia', *American Journal of Clinical Nutrition*, vol. 32, no. 4, pp. 916-925.

Baumgartner, R. N. and E. Pollitt. 1983. 'The Bacon Chow Study: Analyses of the Effects of Infectious Illness on Growth of Infants', *Nutrition Research*, vol. 3, pp. 9-21.

Beaton, G. H. and H. Ghassemi. 1982. 'Supplementary Feeding Programs for Young Children in Developing Countries', *American Journal of Clinical Nutrition*, vol. 35, no. 4, pp. 864-916.

Behrman, J. R. and A. B. Deolalikar. 1986. 'Health and Nutrition', in H. B. Chenery and T. N. Srinivasan, eds., *Handbook of Development Economics* (Amsterdam, North-Holland Publishing Co.).

Bejar, I. I. 1981. 'Does Nutrition Cause Intelligence?: A Reanalysis of the Cali Experiment', *Intelligence*, vol. 5, pp. 49-68.

Black, R. E., K. H. Brown and S. Becker. 1984. 'Malnutrition Is a Determining Factor in Diarrheal Duration, but not Incidence, Among Young Children in a Longitudinal Study in Rural Bangladesh', *American Journal of Clinical Nutrition*, vol. 39, pp. 87-94.

Briscoe, J. 1979. 'The Quantitative Effect of Infection on the Use of Food by Young Children in Poor Countries', *American Journal of Clinical Nutrition*, vol. 32, pp. 648-676.

Cassidy, C. M. 1980. 'Benign Neglect and Toddler Malnutrition', In L. S. Green and F. E. Johnston, eds., *Social and Biological Predictors of Nutritional Status, Physical Growth, and Neurological Development* (New York, N.Y., Academic Press).

Chandler, U. W. 1985. 'Investing in Children', Worldwatch Paper No. 64 (Washington, D.C., Worldwatch Institute).

Chavez, A. and C. Martinez. 1981. 'School Performance of Supplemented and Unsupplemented Children from a Poor Rural Area', in A. E. Harper and G. K. Davis, eds., *Nutrition in Health and Disease and International Development: Symposia*

from the XII International Congress on Nutrition. Vol. 77, *Progress in Clinical and Biological Research* (New York, N.Y., Alan R. Liss, Inc.).

Chavez, A., C. Martinez and T. Yaschine. 1985. 'Nutrition, Behavioral Development, and Mother-Child Interaction in Young Rural Children', *Federation Proceedings*, vol. 34, pp. 1574-82.

Chen, L. C., E. Huq and S. L. Huffman. 1981. 'A Prospective Study of the Risk of Diarrheal Diseases According to Nutritional Status of Children', *American Journal of Epidemiology*, vol. 114, pp. 284-292.

Chen, L. C. and N. S. Scrimshaw. 1983. *Diarrhea and Malnutrition* (New York, N.Y., Plenum Press).

Christiansen, N., L. Vuori, J. O. Mora and M. Wagner. 1974. 'Social Environment as it Relates to Malnutrition and Mental Development', in J. Cravioto, L. Hambreus and B. Vahlquist, eds., *Early Malnutrition and Mental Development* (Uppsala, Sweden, Almquist and Wiksell).

Cravioto, J., E. R. DeLicardie and H. G. Birch. 1966. 'Nutrition, Growth, and Neurointegrative Development: An Experimental and Ecological Study', *Pediatrics*, vol. 38, no. 2, part II, pp. 319-372.

Dasen, P. M., M. Lavallee, J. Retschlitzky and M. Reinhardt. 1977. 'Early Moderate Malnutrition and the Development of Sensory-Motor Intelligence', *Journal of Tropical Pediatrics, Environment and Child Health*, vol. 23, pp. 146-157.

Davies, C. T. M., J. R. Brotherhood, K. J. Collins, C. Dore, F. Imms, J. Musgrove, J. S. Weiner, M. A. Amin, H. M. Ismail, M. El Karim, A. H. S. Omer and M. Y. Sukker. 1976. 'Energy Expenditure and Physiological Performance of Sudanese Cane Cutters', *British Journal of Industrial Medicine*, vol. 33, pp. 181-186.

Delgado, H. S., V. Valverde, J. M. Belizan and R. E. Klein. 1983. 'Diarrheal Diseases, Nutritional Status and Health Care: Analyses of Their Interrelationships', *Ecology of Food and Nutrition*, vol. 12, pp. 229-234.

Dobbing, J. 1985. 'Infant Nutrition and Later Achievement', *The American Journal of Clinical Nutrition*, vol. 41, no. 2, pp. 477-484.

Engel, P. L. 1980. 'The Intersecting Needs of Working Women and Their Young Children: A Report to the Ford Foundation', paper prepared for the Ford Foundation (draft).

Engel, P. L. 1986. 'The Intersecting Needs of Working Mothers and Their Young Children: 1980 to 1985' (San Luis Obispo, Calif., California Polytechnic State University).

Esrey, S. A., R. G. Feachem and J. M. Hughes. 1985. 'Interventions for the Control of Diarrheal Diseases Among Young Children: Improving Water Supplies and Excreta Disposal Facilities', *Bulletin of the World Health Organization*, vol. 63, no. 4, pp. 757-772.

Feachem, R. G. 1983. 'Interventions for the Control of Diarrheal Diseases Among Young Children: Supplementary Feeding Programs', *Bulletin of the World Health Organization*, vol. 61, no. 6, pp. 967-979.

Feachem, R. G. and M. A. Koblinsky. 1984. 'Interventions for the Control of Diarrheal Diseases Among Young Children: Promotion of Breastfeeding', *Bulletin of the World Health Organization*, vol. 62, pp. 271-291.

Garcia, M. H. 1984. 'Preliminary Results from the Pilot Food Discount Experiment in the Philippines', paper presented for the Workshop on Consumer-Oriented Food Subsidies at IFPRI, Washington, D.C., May 15-17.

Geber, M. and R. F. A. Dean. 1956. 'The Psychological Changes Accompanying Kwashiorkor', *Courrier*, vol. 6, pp. 3-14.

Ghosh, S. and P. S. Dhatt. 1961. 'Complications of Measles', *Indian Journal of Child Health*, vol. 10, pp. 111-119.

Gillespie, D. G., M. E. Mamlouk and K-H. M. Chen. 1983. 'Cost Effectiveness of Family Planning: Overview of the Literature', in I. Sirageldin, D. Salkever, and R. W. Osborn, eds., *Evaluating Population Programs: International Experience with Cost-Effectiveness Analysis and Cost-Benefit Analysis* (New York, N.Y., St. Martin's Press).

Goldman, R. H. and C. A. Overholt. 1981. 'Study VI: Agricultural Production, Technical Change, and Nutritional Goals', in J. E. Austin and M. F. Zeitlin, eds., *Nutrition Intervention in Developing Countries* (Cambridge, Mass., Oelgeschlager, Gunn and Hain, Publishers, Inc.).

Gordon, J. E., W. Ascoli, L. J. Mata, M. A. Guzman and N. S. Scrimshaw. 1968. 'Nutrition and Infection Field Study in Guatemalan Villages, 1959-1964', VI, 'Acute Diarrheal Disease and Nutritional Disorders in General Disease Incidence', *Archives of Environmental Health*, vol. 16, pp. 424-437.

Guzman, M. A., N. S. Scrimshaw, H. A. Bruch and J. E. Gordon. 1968. 'Nutrition and Infection Field Study in Guatemalan Villages, 1959-1964'. VII, 'Physical Growth and Development of Preschool Children', *Archives of Environmental Health*, vol. 17, pp. 107-118.

Gwatkin, D. R. 1983a. 'Does Better Health Produce Greater Wealth? A Review of the Evidence Concerning Health, Nutrition, and Output', report prepared for the U.S. Agency for International Development (Washington, D.C., Overseas Development Council).

Gwatkin, D. R. 1983b. 'Child Spacing in the Third World. What Has Been Happening? What Can Be Done?' (draft).

Gwatkin, D. R., J. Wilcox and J. Wray. 1980. *Can Health and Nutrition Interventions Make a Difference*, monograph no. 13 (Washington, D.C., Overseas Development Council).

Haaga, J., C. Kendrick, K. Test and J. Mason. 1985. 'An Estimate of the Total Prevalence of Child Malnutrition in Developing Countries', *World Health Statistics Quarterly*, vol. 38, no. 3, pp. 331-347.

Halpern, R. and R. Myers. 1985. 'Effects of Early Childhood Intervention of Primary School Progress and Performance in Developing Countries', paper prepared for U.S. Agency for International Development, Bureau for Program and Policy Coordination (Ypsilanti, Mich., High/Scope Educational Research Foundation).

Helmendinger, J., M. Zeitlin and J. Austin. 1981. 'IV Formulated Foods', in J. Austin and M. Zeitlin, eds., *Nutrition Interventions in Developing Countries* (Cambridge, Mass., Oelgeschlager, Gunn and Hain Publishers, Inc.).

Hicks, N. 1980. 'Economic Growth and Human Resources', World Bank Staff Working Paper No. 408 (Washington, D.C., the World Bank).

Ho, T. J. 1985. 'Economic Issues in Assessing Nutrition Projects: Costs, Affordability and Cost Effectiveness' (Washington, D.C., the World Bank, Population, Health and Nutrition Department).

Hornik, R. 1985. 'Nutrition Education: A State-of-the-Art Review', Nutrition Policy Discussion Paper no. 1 (Rome, Food and Agriculture Organization).

Horton, S. and T. King. 1981. 'Labor Productivity: Un Tour d'Horizon', World Bank Staff Working Paper no. 497 (Washington, D.C., the World Bank).

Huffman, S. L. 1984. 'Child Spacing', *Mothers and Children: Bulletin on Infant Feeding and Maternal Nutrition*, vol. 4, no. 1, pp. 1-2.

Immink, M., F. E. Viteri, R. Flores and B. Torun. 1984. 'Microeconomic Consequences of Energy Efficiency in Rural Populations in Developing Countries' in E. Pollitt and P. Amante, eds., *Energy Intake and Activity*, vol. 11, *Current Topics in Nutrition and Disease* (New York, N.Y., Alan R. Liss, Inc.).

Irwin, M., P. Engel, C. Yarbrough, R. Klein and J. Townsend. 1978. 'The Relationship of Prior Ability and Family Characteristics to School Attendance and School Achievement', *Child Development*, vol. 49, pp. 415-427.

Isenman, P. 1980. 'Basic Needs: The Case of Sri Lanka'. *World Development*, vol. 8, pp. 237-258.

James, J. W. 1972. 'Longitudinal Study of the Morbidity of Diarrheal and Respiratory Infections in Malnourished Children', *American Journal of Clinical Nutrition*, vol. 25, pp. 690-694.

Jamison, D. T. 1986. 'Child Malnutrition and School Performance in China', *Journal of Development Economics*, vol. 20, no. 2, pp. 299-310.

Jimenez, E. 1987. *Pricing Policy in the Social Sectors: Cost Recovery for Education and Health in Developing Countries*, (Baltimore, Md., Johns Hopkins University Press).

Kennedy, E. and H. Alderman. 1985. 'Comparative Analyses of Nutritional Effectiveness of Selective Interventions' (Washington, D.C., International Food Policy Research Institute).

Kennedy, E. T. and M. Kotelchuck. 1984. 'The Effect of WIC Supplemental Feeding on Birth Weight: A Case-Control Analysis'. *American Journal of Clinical Nutrition*, vol. 40, pp. 579-585.

Klein, R. E. 1979. 'Malnutrition and Human Behavior: A Backward Glance at an Ongoing Longitudinal History', in D. A. Levinsky, ed., *Malnutrition, Environment, and Behavior: New Perspectives* (Ithaca, N.Y., Cornell University Press).

Kielmann, A. A., C. A. Ajello and N. S. Kielmann. 1982. 'Nutrition Intervention: An Evaluation of Six Studies', *Studies in Family Planning*, vol. 13, no. 8/9, pp. 246-257.

Koopman, J. S., L. Fajardo and W. Bertrand. 1980. 'Food Sanitation and the Socioeconomic Determinants of Child Growth in Colombia'. *American Journal of Public Health*, vol. 71, pp. 31-37.

Koster, F. T., G. C. Curlin, K. M. A. Azziz and A. Haque. 1981. 'Synergistic Impact of Measles and Diarrhea on Nutrition and Mortality in Bangladesh', *Bulletin of the World Health Organization*, vol. 59, no. 6, pp. 901-908.

Kumar, S. K. 1979. 'Impact of Subsidized Rice on Food Consumption and Nutrition in Kerala', Research Report No. 5 (Washington, D.C., International Food Policy Research Institute).

Lasky, R. E., R. E. Klein, C. Yarbrough, P. L. Engel and A. Lechtig. 1981. 'The Relationship Between Physical Growth and Infant Behavioral Development in Rural Guatemala', *Child Development*, vol. 52, pp. 219-226.

Levin, H. M. 1986. 'A Benefit-Cost Analysis of Nutritional Programs for Anemia Reduction', *World Bank Research Observer*, vol. 1, no. 2, pp. 219-245.

Lockheed, M., D. Jamison and L. Lau. 1980. 'Farmer Education and Farm Efficiency: A Survey', *Economic Development and Cultural Change*, vol. 29, pp. 37-76.

Lunn, P. G., S. Austin, A. M. Prentice and R. G. Whitehead. 1980. 'Influence of Maternal Diet on Plasma-Prolactin Levels During Lactation', *The Lancet*, vol. 1, pp. 623-625.

Manoff International, Inc. 1984. 'Project Description: Nutrition Communication and Behavior Change Component, Indonesian Nutrition Development Program' (Washington, D.C., Manoff International, Inc.).

Manoff, R. K. 1982. 'Nutrition Education: Lessons Learned', *Mothers and Children—Bulletin on Infant Feeding and Maternal Nutrition*, vol. 2, no. 3, pp. 1-4.

Martorell, R. 1986. 'Evaluation of the Tamilnadu Integrated Nutrition Project', paper presented at the 12th session of the ACC Sub-Committee on Nutrition, Tokyo, Japan, April 7-11.

Martorell, R. and C. Yarbrough. 1983. 'The Energy Cost of Diarrheal Diseases and Other Common Illnesses of Children', in L. C. Chen and N. S. Scrimshaw, eds., *Diarrhea and Malnutrition* (New York, N.Y., Plenum Press).

Martorell, R., J-P. Habicht, C. Yarbrough, A. Lechtig, R. E. Klein and D. Western. 1975. 'Acute Morbidity and Physical Growth in Rural Guatemalan Children', *American Journal of Diseases of Children*, vol. 129, pp. 1296-1301.

Mata, L. 1978. *The Children of Sta. Maria Cauque: A Prospective Field Study of Health and Growth* (Cambridge, Mass., MIT Press).

McGuire, J. Forthcoming. 'Small But Healthy: A Critical Review' (draft, November 1986).

McKay, H., A. McKay, and L. Sinisterra. 1974. 'Intellectual Development of Malnourished Preschool Children in Programs of Stimulation and Nutritional Supplementation', in J. Cravioto, L. Hambreus and B. Vahlquist, *Early Malnutrition and Mental Development*, Symposium of the Swedish Nutrition Foundation XII (Uppsala, Almquist and Wiksell).

McKay, H., L. Sinisterra, A. McKay, H. Gomez and P. Lloreda. 1978. 'Improving Cognitive Ability in Chronically Deprived Children', *Science*, vol. 200, pp. 270-278.

Moock, P. and J. Leslie. 1986. 'Childhood Malnutrition and Schooling in the Terai Region of Nepal', *Journal of Development Economics*, vol. 20, pp. 33-52.

Mora, J. O. et al. 1974. 'Nutrition, Health, and Social Factors Related to Intellectual Performance', *World Review of Nutrition and Dietetics*, vol. 19, pp. 205-236.

Morrison, J. F. and G. T. W. Blake. 1974. 'Physiological Observations on Cane Cutters', *European Journal of Applied Physiology*, vol. 33, pp. 247-254.

Mosley, W. H. and L. C. Chen, eds. 1984. *Child Survival: Strategies for Research* (New York, N.Y., Population Council).

Myers, R. and R. Hertenberg. 'The Eleven Who Survive', a discussion paper prepared for the World Bank, Education and Training Division, 1986.

Mushkin, S. J. 1979. 'Educational Outcomes and Nutrition', in R. E. Klein, M. S. Read, H. W. Reichen, J. A. Brown, A. Pradella, and C. H Daza, eds., *Evaluating the Impact of Nutrition and Health Programs* (New York, N.Y., Plenum Press).

Nutrition Reviews. 1968. 'Measles and Malnutrition', vol. 26, pp. 232-234.

Nutrition Reviews. 1981. 'Infectious Deterrents of Child Growth', vol. 39, no. 9, pp. 328-330.

Nutrition Reviews. 1984.

Pollitt, E. 1984a. 'Risk Factors in the Mental Development of Young Children in the Developing World', Child Development Reference Document. Paper prepared for UNICEF.

Pollitt, E. 1984b. 'Nutrition and Educational Achievement', Nutrition Education series, issue 9 (Paris, UNESCO).

Pollitt, E. and P. Amante, eds. 1984. *Energy Intake and Activity*. Vol. 11, *Current Topics in Nutrition and Disease* (New York, N.Y., Alan R. Liss, Inc.).

Pollitt, E. and A. Eichler. 1976. 'Behavioral Disturbances Among Failure-to-Thrive Children'. *American Journal of Diseases of Children*, vol. 130, pp. 24-29.

Pollitt, E. and C. Thomson. 1977. 'Protein-Calorie Nutrition and Behavior: A View from Psychology', in R. J. Wurtman and J. J. Wurtman, eds., *Nutrition and the Brain*, vol. 2 (New York, N.Y., Raven Press).

Pollitt, E., A. Eichler and C-K. Chan. 1975. 'Psychosocial Development and Behavior of Mothers of Failure-to-Thrive Children', *American Journal of Orthopsychiatry*, vol. 45, no. 4, pp. 525-537.

Popkin, B. M. and M. Lim-Ybanez. 1982. 'Nutrition and School Achievement', *Social Science and Medicine*, vol. 16, pp. 53-61.

Prentice, A. M., M. Watkinson, R. G. Whitehead, W. H. Lamb and T. J. Cole. 1983. 'Prenatal Dietary Supplementation of African Women and Birth Weight', *The Lancet*, vol. 1, pp. 489-492.

Psacharapoulos, G., J-P. Tan and E. Jimenez. 1986. *Financing Education in Developing Countries: An Exploration of Policy Options* (Washington, D.C., the World Bank).

Puffer, R. and C. Serrano. 1973. *Patterns of Mortality in Childhood* (Washington, D.C., Pan American Health Organization).

Richardson, S. A. 1976. 'The Relation of Severe Malnutrition in Infancy to Intelligence of School Children with Differing Life Histories', *Pediatric Research*, vol. 10, pp. 57-61.

Richardson, S. A. and H. G. Birch. 1973. 'School Performance of Children Who Were Severely Malnourished in Infancy', *American Journal of Mental Deficiency*, vol. 77, no. 5, pp. 623-632.

Robertson, R. L. 1985. 'Review of Literature on Costs of Health Services in Developing Countries', report prepared for the World Bank, Population, Health and Nutrition Department.

Russell, M. 1976. 'The Relationship of Family Size and Spacing to the Growth of Preschool Mayan Children in Guatemala', *American Journal of Public Health*, vol. 66, no. 12, pp. 1165-71.

Salkever, D. and I. Sirageldin. 1983. 'Cost-Benefit and Cost-Effectiveness Analysis in Population Programs: Its Role in Program Planning and Management', in I. Sirageldin, D. Salkever and R. W. Osborn, eds., *Evaluating Population Programs: International Experiences with Cost-Effectiveness Analysis and Cost-Benefit Analysis* (New York, N.Y., St. Martin's Press).

Schultz, W. 1980. *Investing in People: The Economics of Population Quality* (Berkeley, Calif., University of California Press).

Scrimshaw, N. S., M. A. Guzman, M. Flores and J. E. Gordon. 1968. 'Nutrition and Infection Field Study in Guatemalan Villages, 1959-1964', *Archives of Environmental Health*, vol. 16, pp. 223-234.

Seckler, D. 1979. 'Small But Healthy? Some Basic Problems in the Concept of Malnutrition' (photocopy).

Selowsky, M. 1981. 'Nutrition, Health, and Education: The Economic Significance of Complementarities at Early Age', *Journal of Development Economics*, vol. 9, pp. 331-346.

Selowsky, M. and L. Taylor. 1973. 'The Economics of Malnourished Children: An Example of Disinvestment in Human Capital', *Economic Development and Cultural Change*, vol. 22, no. 1, pp. 17-30.

Sommer, A., J. Katz and I. Tarwotjo. 1984. 'Increased Risk of Respiratory Disease and Diarrhea in Children with Preexisting Mild Vitamin A Deficiency', *American Journal of Clinical Nutrition*, vol. 40, pp. 1090-95.

Sommer, A., G. Hussaini, I. Tarwotjo and D. Susanto. 1983. 'Increased Mortality in Children with Mild Vitamin A Deficiency', *The Lancet*, vol. 2, pp. 585-588.

Sommer, A., E. Djunaedi, A. A. Loeden, I. Tarwotjo, K. West, R. Tilden and L. Mele. 1986. 'Impact of Vitamin A Supplementation on Childhood Mortality: A Randomized Controlled Community Trial', *The Lancet*, vol. 1, pp. 1169-73.

Sosa, R. 1976. 'Feed the Nursing Mother, Thereby the Infant', *Tropical Pediatrics*, vol. 88, no. 4, pp. 668-670.

Spurr, G. B. 1983. 'Nutritional Status and Physical Work Capacity', *Yearbook of Physical Anthropology*, vol. 26, pp. 1-35.

Spurr, G. B. 1984. 'Physical Activity, Nutritional Status, and Physical Work Capacity in Relation to Agricultural Productivity', in E. Pollitt and P. Amante, eds., *Energy Intake and Activity*. Vol. 11, *Current Topics in Nutrition and Disease* (New York, N.Y., Alan R. Liss, Inc.).

Spurr, G. B., M. Barac-Nieto and M. G. Maksud. 1977. 'Energy, Productivity, and Maximal Oxygen Consumption in Sugarcane Cutters', *American Journal of Clinical Nutrition*, vol. 30, pp. 316-321.

Tognetti, J. ca. 1985. 'Evaluating Breastfeeding Promotion Programs: A Note on Past Experiences and Directions for Future Research'. Photocopy, Educational Development Center, Newton, Mass.

Tomkins, A. 1981. 'Nutritional Status and Severity of Diarrhea Among Preschool Children in Rural Nigeria', *The Lancet*, vol. 1, pp. 860-862.

Trowbridge, F. L., L. H. Newton and C. C. Campbell. 1981. 'Letter to the Editor', *The Lancet*, vol. 1, pp. 1374-1375.

Trussell, J. and J. Menken. 1984. 'Estimating Levels, Trends, and Determinants of Child Mortality in Countries with Poor Statistics', *Population and Development Review*, vol. 10, supplement, pp. 325-346.

Viteri, F. and B. Torun. 1975. 'Ingestión Calorica y Trabajo Fisico de Obreros Agrícolas en Guatemala', *Boletin de la Oficina Sanitaria Panamericana*, vol. 78, no. 1, pp. 58-72.

Weber, D., L. Vuori-Christiansen, N. Ortiz, J. R. Clement, N. E. Christiansen, J. O. Mora, R. B. Reed and M. G. Herrera. 1981. 'Nutritional Supplementation, Maternal Education, and Cognitive Development of Infants at Risk of Malnutrition', *American Journal of Clinical Nutrition*, vol. 34, no. 4, pp. 807-813.

Wheeler, D. 1980. 'Human Resource Development and Economic Growth in Developing Countries: A Simultaneous Model', World Bank Staff Working Paper No. 407 (Washington, D.C., the World Bank).

Whitehead, R. G., M. Hutton, E. Müller, M. G. M. Rowland, A. M. Prentice and A. Paul. 1978. 'Factors Influencing Lactation Performance in Rural Gambia', *The Lancet*, vol. 2, pp. 178-181.

Wilson, D. M., L. D. Hammer, P. M. Duncan, S. M. Dornbusch, P. Ritter, R. L. Hintz, R. T. Gross and R. G. Rosenfeld. 1986. 'Growth and Intellectual Development', *Pediatrics*, vol. 78, no. 4, pp. 646-650.

Winikoff, B. 1983. 'Effects of Birth Spacing on Child and Maternal Health', *Studies in Family Planning*, vol. 14, no. 10, pp. 231-245.

Wray, J. D. 1978. 'Direct Nutrition Intervention and the Control of Diarrheal Diseases in Preschool Children', *American Journal of Clinical Nutrition*, vol. 31, pp. 2073-2082.

Wray, J. D. and A. Aguirre. 1969. 'Protein Calorie Malnutrition in Candelaria, Colombia: Prevalence of Social and Demographic Causal Factors', *Journal of Tropical Pediatrics*, vol. 15, pp. 76-97.

Zeitlin, M. and M. Mansour. 1986. 'Positive Deviance in Child Nutrition: With Emphasis on Psychosocial and Behavioral Aspects and Implications for Development', report prepared for the WHO/UNICEF Joint Nutrition Support Programme.

Zeitlin, M., J. D. Wray, I. B. Stanbury, N. P. Shlossman, M. J. Meurer and P. J. Weinthal. 1982. *Nutrition and Population Growth—The Delicate Balance*. (Cambridge, Mass., Oelgeschlager, Gunn and Hain, Publishers, Inc.)

Zeitlin, M. F. 1981. 'Upper Volta Case Study', Chapter 4 in *Formulated Foods*, Study VI in J. E. Austin and M. F. Zeitlin, eds., *Nutrition Intervention in Developing Countries*. (Cambridge, Mass., Oelgeschlager, Gunn and Hain, Publishers, Inc.)

Zeitlin, M. F., M. Griffiths, R. K. Manoff and T. M. Cooke. 1984. *Vol. VI: Household Evaluation*, 'Nutrition Communication and Behavioral Change Component, Indonesian Nutrition Development Program'. Report by Manoff International, Inc. to Department of Health, Republic of Indonesia.

All correspondence and manuscripts should be addressed to the Chief, Research and Programme Publications Section, Programme Division, UNICEF, UNICEF House, 3 United Nations Plaza, New York, N.Y. 10017, USA.

The designations employed in this publication and the presentation of the material do not imply on the part of the United Nations Children's Fund the expression of any opinion whatsoever concerning the legal status of any country or territory, or of its authorities, or the delimitations of its frontiers.